

THE

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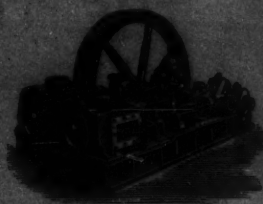
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THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XV.—No. 368.

THE POSTAL TELEGRAPH DEPARTMENT.

THE recent official inspection of the new Instrument Gallery of the General Post Office, by Mr. Shaw Lefevre, the Postmaster-General, may be taken as the forerunner of the coming sixpenny rate telegrams, since the extension of the huge building known as the New General Post Office, was due to the necessities for increased circuit accommodation which the expected extra message work would entail. The two-storied instrument gallery known as "T S" (the old code for "Telegraph Street," where the central station was originally situated) is, and has been for long, by far the largest of the kind in the world; the number of working circuits approaching 1,000, whilst test box accommodation for some 250 more wires is provided. The whole of the latter enter the building underground and terminate at a large test box in the basement of the building, from whence connecting links are carried to somewhat similar test boxes in the upper stories. The battery power employed amounts to the large number of 20,000 cells, chiefly of the Fuller Bichromate and the Chamber Daniell type, though a number of Leclanchés are also in use; many of the latter are of the six block agglomerate kind, and are used as well as the other description of cells for universal working. The latter system has within the last few years been almost universally applied in all large offices to every kind of instrument.

Those who may recollect the class of instruments employed 15 or 20 years back cannot but be struck with the high finish which the apparatus of the present day show. Probably the credit of this change is in no small degree due to Mr. Stroh, in whose factory (now belonging to the department) the high class of work put into the Wheatstone automatic instruments became a pattern for imitation. This high finish which the department requires for all classes of work supplied to them has no doubt been a severe tax to many of the firms who contract to supply the apparatus, and probably no direct benefit accrues to the Post Office from such a standard being insisted upon, but indirectly much good results, as a high outward finish is generally an indication that the important working parts will be made up to the same degree of excellence.

In this country, where climatic changes are so erratic, the good working of duplex and quadruplex apparatus is very dependent upon accurate balances on the artificial line being kept up, and the accurate adjustment of the differential galvanometers used for balancing is consequently of importance; the correct winding of the latter is by no means such an easy matter as might be imagined,

as it is very necessary that the differentiability of the coils on the needle should exist not only when the latter stands at zero, but when it stands at an angle with the coil, a point generally overlooked. The general fitness of the instruments designed by the postal engineers for the purpose for which they are intended is shown by their employment in many cases by several foreign countries, a fact which instrument manufacturers will appreciate. As regards the oft repeated statement that the department stifles invention there is much, no doubt, to be said on both sides, but a great deal of the outside impression is due to the complaints of enthusiastic inventors who do not appreciate the fact that there are many most important points of detail which require to be taken into consideration in designing apparatus, &c., for a particular purpose; which points of detail can only be properly understood, or, indeed, understood at all, by those who have had long practical experience of the circumstances under which the apparatus would be required to work. There is also a tendency, we fancy, for many people to look upon the Postal Telegraph Department as a kind of free public laboratory in which to test the commercial value of their inventions. In automatic working great improvements have been effected; a speed of 400 words per minute having been practically obtained. The necessity for such rapid working will probably be more felt in the future than the present. The fact, however, that the instruments can be made to produce such extreme speeds, renders the facility of their being maintained at a less, though still a high state of efficiency, proportionally great.

ON A METHOD OF MEASURING SMALL RESISTANCES.

By FR. UPPENBORN.

WHEN it is requisite to measure very small resistances, other arrangements must be substituted for Wheatstone's bridge, and recourse had to different methods. In proportion as the resistances to be measured diminish, the resistances of the contacts introduce an element of error which increases continually. It is then necessary to make use of methods by means of which we may compare resistances of very different magnitudes, independently of the resistance of the contacts.

Wheatstone's bridge is a method in which we project electrically, so to speak, the unknown resistance, and a comparative known resistance, upon a conductor, which is by this projection divided into two parts, the resistances or the lengths of which may be easily known or measured. It is therefore plain that if the resistances of the contacts become great in comparison with the true resistances, their projection if enlarged in the same proportion will affect the accuracy of the measurements very sensibly. Setting out with the idea here expressed, it is easy to introduce into Wheatstone's bridge a modification which shall restore the accuracy of the results.

This modification, generally known under the name of Hockin's and Matthiessen's method, is represented in fig. 1:—A wire of nickel silver, of 2 or 3 millimetres in diameter, and of 1 or 2 metres in length, is stretched between the two limits, A and B. From these limits there proceeds a circuit containing the unknown resistance, x , and a known resistance, W , for which the normal unit may be chosen. To effect the electric pro-

jection in question, we establish a difference of potential between the points A and B, connecting each of these limits to one of the poles of a group of elements, P. We then search in the wire, A, B, for a point which has the same potential as the limit, *d*, to which is attached the resistance, *W*, which we assume as the standard resistance. To this end we make use of a very sensitive galvanometer, *e.g.*, the aperiodic galvanometer of Thomson, Siemens, or D'Arsonval. We connect one of the terminals of the galvanometer with the mercurial cup at *d*, and the other limit to a contact which can slide along the wire, A, B, and which is moved until the point, *d'*, is found; that is, until the

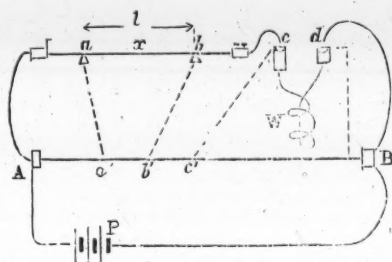


FIG. 1.

galvanometer shows no deviation. The point, *d'*, is then the required projection of the point, *d*. We project by the same method *c*, and determine *c'*. If the resistance to be measured consists of a wire, the specific resistance of which has to be found, it is well not to project the entire length of the wire upon the stretched conductor, A, B, but to operate merely upon its middle portion, *l*, the resistance of which will not be affected by the manipulations which have to be carried on to establish the communication with the terminals. By projecting the two points, *a*, *b*, of the length, *l*, upon A, B we obtain the points *a'*, *b'*. The resistance, *x*, of

the length, *l*, is then : $x = \frac{a'b'}{c'd'} W$.

This equation, however, rests on the supposition that the wire, A, B, is quite homogeneous; that is to say, that any two parts whatever taken of the length of the wire offer an identical resistance, provided they are of the same length. To check the accuracy of this assumption, we have recourse to the method of MM. Strouhal and Barus, which is merely the method of electric projection which we have just explained.

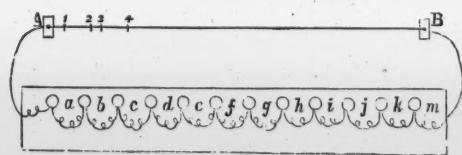


FIG. 2.

For the derived circuit containing the two resistances to be compared, we substitute a series of resistances almost equal among themselves, as is shown in fig. 2.

The resistances are formed of three or four coils of a wire of nickel silver of 2 millimetres in diameter. This wire is coiled upon little rods of dry wood. Each resistance is terminated by strong pieces of copper. The total resistances are arranged upon a small board, which supports a series of cups of mercury. As soon as A and B have been connected to the extremities of a system of batteries, we project the first resistance, *a*, *b*, upon the conductor, A, B, and obtain the points 1 and 2, which have the same potential. It is evident that a projection of this nature is quite independent of the intensity of the current, since this latter element affects simply the numerical value of the potentials, but not

the situation of the points which we may call isopotentials.

We measure then the length of the portion 1 — 2 by means of a rule suitably arranged, and with all the ordinary precautions. We then move the resistances, *a*, *b*, *c*, and proceed to a new projection, which gives the length 3 — 4. We effect thus a series of projections increasing each time by one step the resistance which at the outset was in front of the cups *a*, *b*. By this method we obtain a great number of projections of this same resistance upon the wire, A, B, which is to be calibrated. If this wire is homogeneous in its entire extent, the lengths successively measured are equal; that is to say, we have 1 — 2 = 3 — 4 = 5 — 6, &c.

If, on the contrary, these quantities present sensible differences, it is necessary to proceed to the calibration of the wire, A, B, making use of emery paper. For this purpose we draw up a table showing the lengths projected, as well as the differences with reference to the smallest length which corresponds evidently to the smallest section of the wire. We have thus, *e.g.* :—

Place of Resistance No. 1.	Length <i>l</i> .	Difference.
No. 1	101.3	1.8
2	102.1	2.6
3	103.0	3.5
4	102.5	3.0
5	101.2	1.7
6	100.8	1.3
7	100.2	0.7
8	99.5	0.0
9	99.7	0.2
10	101.2	0.7
11	100.5	1.0
12	100.7	1.2

We rub the wire with emery paper (excepting, of course, the slenderest portion, 99.5), the energy of the friction being proportional to the difference shown in the above table. When this operation is completed, we recommence the series of measurements as already described, until the calibration of the wire is perfect.

By employing a stretched wire of 1.2 metres, we may compare resistances which have among themselves the proportion of 1 — 10, and that with an error less than 0.5 per cent. With a normal standard it is easy to form ten standards, each of $\frac{1}{10}$ ohm, and which when arranged in quantity, enable us to construct $\frac{1}{1000}$ ohm. With this latter standard we are then able to measure resistances of 0.0001 ohm, with an accuracy of 0.0000005 ohm.

We have made use of the method of Hockin and Matthiessen for the determination of the conductivity of different copper wires, employing a normal Siemens unit of the form of a box. When we have to do with determinations of this kind, the section of the wire whose conductivity is to be ascertained is determined by the length and the weight. These two last measures, considering the perfection of the processes and apparatus now at the command of physicists, we ascertained with great accuracy. The method of MM. Hockin and Matthiessen has been already published in the excellent treatise of Maxwell on Electricity and Magnetism, Vol. 1, p. 406. We have considered it interesting to describe this process here in a slightly modified form, which shows well the generality of the procedure.

The method of the electric projection of resistances presents incontestable advantages, and may be applied in a great number of cases which electricians meet with in practice. Their only defect is the multiplicity of measurements, since it is necessary to make four different operations with the galvanometer, in order to find the relation of the two resistances.

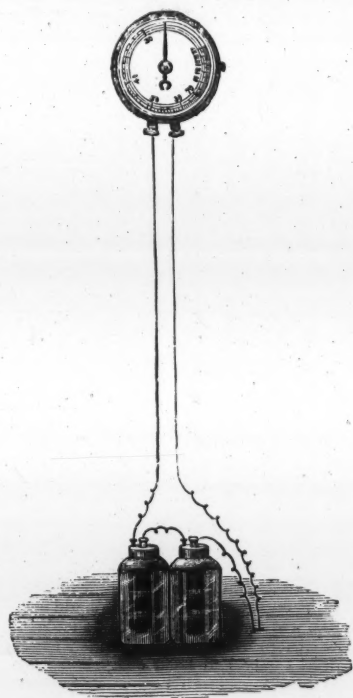
Physical Society.—Professors A. W. Reinold and A. W. Rücker have prepared a paper on "The effect of an electrical current on the rate of thinning of a liquid film," to be read at the meeting of the Physical Society to-day (the 13th inst.). A paper by Mr. Herbert Tomlinson, on "A theory of the molecular architecture of solids, illustrated by a wire vibrating torsionally," will also be read.

ELECTRICAL SPEED INDICATORS.

OUR illustrations represent Messrs. Farquharson and Lane's patent electrical speed indicator specially designed for use on board ship for indicating the number of revolutions per minute at which an engine is running—of course there are a number of other uses to which this instrument may be applied, such as checking the speed of dynamos, &c., which are self evident.

The design of the instrument is certainly novel, and, from its simplicity, compactness, and reliability, should commend itself for these purposes.

A small commutator is fixed upon the shaft of the engine or other piece of machinery, the speed of which it is required to note, and upon this a contact brush is made to bear. The commutator is so arranged that at each revolution of the shaft one contact only for an instant is made; the shaft is in connection with one pole of a battery, the other pole being connected to earth. The contact brush is joined by means of an insulated wire to the indicator and from thence to earth.



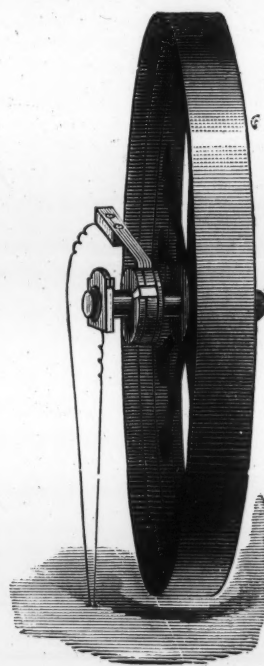
It is evident that with a shaft travelling a given number of revolutions per minute, the interval of time between each completion of the circuit by the revolution of the commutator against the brush would be a constant interval, its length being in accordance with the speeds. The indicator is so constructed that by pressing a button on the side of the instrument the circuit is complete the instant the commutator on the shaft has come in contact with the rubbing brush. By means of an electro magnet placed within the indicator, at the instant the circuit is completed the pointer is released and continues to move round the dial until the commutator on the shaft has again come in contact with the brush and completed the circuit a second time; at this moment the pointer will be instantaneously stopped.

The rate at which the hand travels being constant, it follows that the interval of time taken for the hand to move would be the same as that taken for one revolution of the shaft, and if, therefore, instead of marking the number of seconds or parts of seconds upon the dial of the instrument, the speed is marked corresponding to that interval of time, it follows that the speed of the shaft may be indicated. For instance, supposing a shaft to be travelling at the rate of 60 revolutions per minute, it would take one second to each revolution. Now the pointer in this space of

time would have travelled a certain distance round the dial; if at this point the figure 60 is marked it will represent the number of revolutions of the shaft per minute. The other speeds of course would also be marked upon the dial in each case corresponding to the time taken by the shaft to complete one revolution.

In order that the rate at which the pointer travels may be perfectly uniform, it is, previous to each observation, replaced to its zero position, the mechanism being so arranged that the replacing of the pointer to zero winds up the spring actuating the mechanism of the instrument and thus ensures a constant motive power. The mechanism of the indicator has been very carefully designed so as to ensure great accuracy in its action, and at the same time it is simple in its construction and not liable to get out of order.

A further point we would mention is that from the construction of the instrument the revolutions of the shaft may be read off by sound as well as by the indication on the dial. This, under many circumstances, would be found an advantage. By this means a thorough check can be kept upon the adjustment of the indicator.



A number of these indicators may be connected by a single wire in different parts of a factory or steamship, the same battery used for one being sufficient to work the whole of them. Again, the distance at which the indicator may be placed from the shaft is, within reasonable limits, immaterial. The battery will only be in action at the moment the indicator is being used, so that the battery power expended would be in direct proportion to the number of readings taken. It is evident, therefore, that for a variety of purposes this indicator would be very applicable, such as indicating the speed of dynamos, engines of steamships, &c., &c., and we feel sure that it only requires to be thoroughly known to be largely employed. We have to congratulate Messrs. Farquharson and Lane on the skill they have shown in perfecting this apparatus which, in our hands, has been subjected to severe tests without showing any defect or weakness in any part.

Latimer Clark, Muirhead and Co., Limited, at whose works this apparatus may be seen in action, have been appointed by the inventors the sole manufacturers.

City and Guilds of London Institute.—The Earl of Selborne, Lord Chancellor, last week distributed the prizes and certificates awarded at the last examinations at this institute.

APPARATUS FOR TESTING LIGHTNING
CONDUCTORS.

THIS apparatus, constructed by Messrs. C. and E. Fein, of Stuttgart, consists of a Wheatstone bridge and some accessories necessary for use with the same. The instruments are contained in two boxes; that represented by fig. 1 contains a bichromate of potash element, a

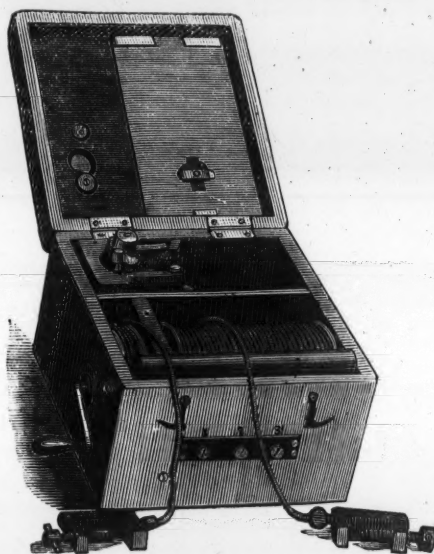


FIG. 1.

drum holding two conductors of low resistance, the ends of which are furnished with terminals, and an earth plate of copper which is as pliable as a handkerchief. The other box (fig. 2) contains the measuring apparatus.



FIG. 2.

This is a Wheatstone bridge with a resistance for comparison. The wire which serves for the measurements is stretched around a disc of slate. Measurements can be made from 0.5 to 25 ohms, which are sufficient for the purpose.

Technical Education.—At the last meeting of the London School Board, the Rev. T. C. Morse brought forward a motion advocating the establishment of a central school by the board for advanced instruction in technical work and industrial employments. The subject, however, was not fully discussed, and was adjourned.

ELECTRIC LIGHTING IN AMERICA.*

IN the discussion following the paper read by Mr. W. H. Preece, at the Society of Arts:—

Admiral Sir E. OMMANNEY asked if Mr. Preece would describe the lighting of Madison-square, New York?

Mr. PREECE said this square, which was about the size of St. James's-square, was lit up by one of the tall masts he had described, 200 feet high, having a circle round the top of eight Brush lamps. The effect was very good, the whole square being brilliantly illuminated, the outline of the shrubs and trees being very distinct. It was, however, hardly necessary to describe it, as the same thing was to be seen at the Health Exhibition.

Mr. CROMPTON said it was difficult to add anything to what Mr. Preece had stated, for he had pointed out very fully all the causes which had led to the great development of electric lighting in America. One of these was the lawless manner in which overhead wires were carried about all over the towns, a system which was utterly impossible here, so that arc lighting in England had to be confined to isolated installations. The high tension system of lighting was comparatively easy to work out, and if there were equal facilities here, probably as much would have been accomplished as in America. It was true that the Americans had so much greater faith in the new illuminant, that large capital had been put in Mr. Edison's hands, and thus he had been able to carry out a large experiment in New York, from which valuable lessons could be learned, such as only could be learned from working on a large scale with a central station. The main points to be noticed were the success of the meters, and the general success in keeping the lights going continuously. But when you came to details of lamps and dynamos, the Americans were not ahead, but somewhat behind ourselves. The invention of tannidine by Mr. Weston was nothing new; it was simply dried cellulose, which Mr. Swan, Mr. Crookes, and others had used almost from the commencement; the only new thing seemed to be the zigzag shape of the filament; and to call this a new invention reminded him of what was said to have been done in the way of inventing a new dynamo, viz., taking someone else's, and painting it a different colour. Mr. Preece said the glow lamps were not to be compared in efficiency with those of Woodhouse and Rawson; and other information he had himself received confirmed that view. Some very interesting figures had been given with regard to the consumption of coal to produce a certain quantity of light; they certainly gave a higher efficiency to the performance of the Edison dynamos and lamps in New York than he had obtained from other quarters, but even taking those figures, they gave the coal used per candle at .052 lbs., whereas in this country the average number of large installations gave .021 lbs. The difference was due to three causes; 1st, the much higher efficiency of the compound steam-engines now used in England; 2nd, the greater efficiency of the dynamos used here; and 3rd, the extra efficiency of the Swan lamps as compared with the Edison. It had nothing to do with the price of coal, as he had worked it out entirely by reference to the weight. Mr. Weston's dynamo only followed the same lines on which Dr. Hopkinson, himself, and others had been working for some time past. The electromotive force, in volts, per ohm of resistance of the armature was not so high in America as had been obtained in this country by Dr. Hopkinson and himself, and he believed also by the Ferranti and Gordon alternating current machines. He could not agree with Mr. Preece that there was much reduction to be looked for in the cost of the machines; there was already so much competition in the manufacture, that many had been compelled to retire from the field; but there was considerable economy to be hoped for when the light became general, and when all the accessories and small fittings became articles of common manufacture. The dynamo was spoken of as if it formed the most expensive portion of the plant, but it was not so. In an installation costing £1,000, very often the dynamo and steam-engine together only came to £250 or £280, the remainder being made up of the extremely high cost of engineering, having to send a highly-paid man a long distance, and his being often kept waiting about many days, on a job which could only be compared with one on which a gasfitter at 30s. a week would be employed. It was this which made electric lighting so costly on a small scale.

Mr. SELLON said the question of secondary batteries had been alluded to, but in his opinion it was so important that he should prefer reserving any remarks upon it until another occasion, when it might form the principal topic of the discussion.

Prof. G. FORBES said he felt, when going over part of the same ground as Mr. Preece, that he was learning something at every step; many of his old prejudices had disappeared, and he had determined to try and convince others of the error of some of the opinions held here. The subject had been divided naturally into the two branches of incandescent and arc lighting. He agreed with Mr. Preece that in this country we were far ahead of the Americans in incandescent lighting, especially in the lamps, though they had more experience in lighting from central stations. The general result was that in England the life of a lamp was at least twice as long as in America, and the cost of working for the same candle-power about one-half. The Americans must have full credit, however, not only for their practical work with regard to central stations, but also for the thorough way in which they had laid out their plans theoretically for working those stations. He had never yet seen in this country a specification or estimate for an installa-

* See ELECTRICAL REVIEW for last week.

tion which was complete and satisfactory in its mode of distributing the potential about the district; and the more he thought of it, the more he was driven to the conclusion that the most sound and practical arrangement was the one introduced by Mr. Edison in New York. He did not allude to the three-wire system, which was a mere matter of detail, but to the distributing boxes with feeding mains going to them, and with telegraph wires coming back to the engine-room, stating what was the potential at these different points, so that it could be regulated as required. The Americans were entitled to full credit for this beautiful system. With reference to the meters, Mr. Preece said he found that they worked very satisfactorily in New York, and he had given a most wonderful confirmation of that—an instance in which, after a month's working with four lamps, the time of which was carefully counted, there was only a difference of two lamp hours. This was a far greater degree of accuracy than could have been anticipated or was given by any gas meter, and he wished he could have the same confidence in the method, but the information he had received had not been so satisfactory. One person told him that when the bill came in at the end of the first month, he was so aghast at its dimensions that he complained of it, as it was several times the cost of gas, and the examiner of meters agreed with him that he should pay what the gas had cost him previously. That was an easy way of settling the matter, but did not seem to support the character of the meter. Again, he carefully examined the arrangements in the *New York Times* office, and when he came to the crucial question of the cost, he was informed that they were to get the same light as before, and pay the same as they had paid for gas. With regard to arc lighting, he had learned a good deal in America. After the dynamo machine was first introduced by Gramme, it was considered a very important point to have a large number of sections in the commutator, and it had always been considered here, that the introduction of a large number was one of the greatest improvements; but in America they had gone on a totally different tack, and had reduced the sections to the smallest possible number. It must be very astonishing to Englishmen to find such efficiency attained on this plan. Another point on which they were conspicuous was in the regulation of the current over large districts, which they had attained by their greater experience, arising from the much greater facilities which they possessed. Experience in England showed that, especially when using small currents, there was great difficulty in regulating the strength. It seemed to be in a position of unstable equilibrium, so that the slightest change in the resistance of the lamps altered the current considerably. To meet this difficulty, the Americans had introduced regulators, the Thomson and Houston system, using double regulators to increase the sensitiveness, by which means the current was maintained constant, whatever the number of lamps which were put in or out of circuit. Another reason why the system was so largely adopted in America, was that they were allowed to use overhead wires, and it was on this point that his opinions had changed. Many had looked on high potential machines as being dangerous, and on overhead wires as being both dangerous and unsightly. It was undoubtedly true that high tension machines were more dangerous than low, but yet the number of fatal accidents in America, with 90,000 lamps, had been fewer even than in this country; this being due to the careful way in which the wires were insulated, and the installation carried out. As to the unsightliness of the wires, he could only say, having spent most of his time in Philadelphia, that though they looked unsightly at first that feeling soon wore off, and by the time he left he looked upon them as being not at all objectionable, and he should not now object to see them in London. He could not help thinking that when the great advantages of the electric light, so desirable in the interests of the public safety and morality, were considered, the objection to the use of high potentials would be waived.

Mr. HAMMOND said it was not his privilege to go to America with the British Association, but he was there last year, and did not keep so much to the east as Mr. Preece had done. After leaving Chicago, he again found the electric light at Denver, in Colorado, in Salt Lake City, and in San Francisco, where he found, perhaps, the finest hotel in the world lighted throughout by electricity. The Americans, therefore, had gone much farther ahead than we had, but it was very desirable to draw the correct lessons from what was to be seen there. They were sometimes told that the English were very slow, but it was not entirely due to want of enterprise that in this matter we were behind the States. One great point was the price of gas, which was much dearer in America than in England. Again, many of these contracts in America, though they might not involve any loss, did not show any profit. In order to get sole control of a town, the municipality had in some way to be accommodated, and this was done by supplying them with the electric light at 50 cents per night; but it would not pay even here to supply an arc light of 2,000 candles at £35 per annum; at any rate if you did not lose, you would make nothing by it. There were many cases where the price was double and treble, and where good profits were being made, but it was in localities like Salt Lake City, where people had plenty of money to spend, and where gas was about 17s. a thousand, that the best place for the electrical engineer was to be found. In some places in the west they had no light at all, and would have given anything for the electric light. Again, the Americans were very enterprising in business; they worshipped the almighty dollar, and looked upon the electric light as a good advertisement. A man would, for the sake of outshining his rival, put the most flickering arc light outside his door, and his experience was that the American arc lights were far behind our own. Again, the heat there was very great, and whilst in Eng-

land some people liked the warmth of gas, in America no one would go to an hotel not lighted by electricity, if there were one opposite which was. It was, however, used simply for business, and was an advertisement. The man who would have it in his store would not think of using it at home to make it more comfortable, because it cost too much. Gradually, however, some of the leading Americans were introducing it for domestic purposes; but when he was in New York, Mr. Edison had not got it in his new house, and Mr. Brush had not got it in his in Cleveland. It was remarkable to see the effect the overhead wires had had on Professor Forbes. An Englishman in New York would think London a peaceful village in comparison. There was a railway overhead, the passengers on which could converse with the people at the first floor windows along the route, and there were these posts with 60 and 70 wires on them all along the principal streets; in Fifth Avenue they were worse than anywhere. He did not mind them himself, but they must not regard this matter simply from the point of view of those who lived by electric lighting, and he was sure such things would not be tolerated in England. There was no Board of Trade in America, but he was sure they would find it better eventually to put the wires underground, when the system was firmly established. But directly they wanted to put them underground in England, they had to apply to Parliament for permission; in America it was only necessary to find out the man who represented the municipality, and the matter was easily arranged over a long drink at the bar. That was local option; but in England they had to go to Parliament. As they urged on Mr. Chamberlain the other day, why should not the local authorities be empowered to grant liberty to any company, in whom they had confidence, to put wires underground? It was a mere accident of their industry that they had to deliver electricity by wires; if they could deliver it like other wares, by van, they would not need to ask Parliament anything about it; but because they had to use wires, a delay of some eighteen months, and all kinds of difficulties stood in their way. The great lesson to be learned from America was that it could be done. There were hundreds and thousands of people ready to pay double the price of gas for the electric light, but capitalists were constantly saying they were told it could not be done. Mr. Edison had shown in New York that incandescent lighting could be supplied from a central station, and that when done on a large scale, the risk of failure was infinitesimal. In New York they were able to make a small margin of 3 per cent., using 5 watts per candle, getting 7s. 9d. for it, and paying three-fourths for the manufacture. In England it could be produced with 3 watts per candle, at a cost for manufacture of 3s. 8d., instead of 6s. All the installations in America had been made in one way, taking the current direct into the houses. A reference had been made to storage batteries, but in no case had they yet been used as a part of a general system, as we hoped would soon be introduced in London, and with a much less capital outlay. If in New York they could make 3 per cent. on a capital of £200,000, which included an immense amount sunk in experiments, they might hope in England, to make 8 per cent. on a capital of £70,000, which would be sufficient, with proper plant, and the advantage of further experience; and by working at three-fifths the cost, they might even hope to make 12 per cent.

The CHAIRMAN said no one had referred, except the last speaker incidentally, to what was the great obstacle to the progress of electric lighting in England, viz., that owing to the wires having to be put under the streets, the belief being entertained (though that was a moot point) that the local authorities had no power to grant permission for this, and that Parliament had to be applied to. Mr. Hammond had spoken as if the only objection to this was the delay and expense in obtaining the Act, and why he and every other speaker had refrained from touching on what was the real obstacle he did not know, but it was a pity to close the discussion without reminding the meeting of what it was that really prevented electric lighting from central stations being carried out in England. It was not simply that an Act of Parliament had to be obtained, but that when obtained it would be unfair, because it would have to be in accordance with a general Act which must have been passed with the express intention of forbidding the progress of electric lighting. Imagine a new steamboat company being started in Liverpool, which would have to use the docks, and assume that these docks belonged to the corporation, and that to be allowed to use them it was necessary to obtain an Act of Parliament, and that the condition of its being allowed to use the docks was that at the end of 20 years, if the company paid a dividend, the corporation should be entitled to purchase the undertaking for the value of the old materials, but if the company did not pay, the corporation should not be obliged to purchase. He said that this appeared to his hearers to be ridiculous; but why was it more ridiculous in connection with a steamboat company than in connection with the distribution of electricity? It was a mere accident that they had to go to Parliament; it was because they required to lay the wires under the streets in the same way as gas companies required to lay gas-pipes. When the Electric Lighting Act was in the House of Commons, the Board of Trade tried to say that at the end of 15 years the local authority in whose district the wires were laid should have the option of purchasing the undertaking, not for what it had cost, but on the then value of the material for their purpose. All apparatus put down in process of developing, which had been removed to make way for better, would not be reckoned as one shilling in the valuation. When the Bill got into the House of Lords, an effort was made to improve it, but the utmost concession obtained was to increase the 15 years to 21; and thus it stands, that, at the end of that

time the company, if the venture paid, must submit to be bought out at the value of the old materials. If it did not pay, no one would care to take it; but the company might go on until they had worked the affair up to a profit, not for their own benefit, but for that of the local authority, for after the first option of purchase, at the end of every five years in perpetuity the option re-rose, and might be exercised to purchase the property for the value of the old materials. Such a monstrous proposition was never heard of. The other way of acquiring property for public purposes was well known, and the public took advantage of it, when it was to their interest. The bridges over the Thames were acquired by the Metropolitan Board of Works when none of the original shareholders were getting a fair dividend, and then the principle of valuation was that of a capitalisation of the net profits made. In this way Waterloo Bridge, which was now as good as the day it was built, and which could not be reproduced, without the approaches, for £750,000, was acquired for about £475,000. No one could object to a valuation based on the capitalisation of profits, if you were to have compulsory powers at all, because it was the true mode of valuing property; but that principle was entirely departed from in the case of electric lighting. Why? Was it a non-meritorious industry, or was it offensive in any way? No; the reason was that gas-lighting had, in many cases, got into the hands of corporations and local boards, and they, having become traders with public money—which, according to the canons of political economy, it was not expedient they should be—they found themselves liable to competition by something better. Thereupon a Bill was passed whereby electric lighting from central sources was strangled. What reasonable man would embark his capital for a twenty-one years' enjoyment of a new industry which you had to educate people to support, and where you had gas being constantly reduced in price. The metropolitan gas companies most properly worked under a sliding scale, whereby, if they reduced the price 1d. per 1,000 ft., they might increase the dividend $\frac{1}{2}$ per cent.; while, on the other hand, if the price were increased 1d. the dividend was diminished in the same ratio of $\frac{1}{2}$ per cent. The result was, the gas companies were stimulated to do their best, and the price was constantly reduced. It was said the other day that the monstrous condition he had mentioned was not a novelty, that a similar one prevailed in the case of tramways; but in the Tramways Act there was the reservation that the local authority should not work the tramways and take the fares, but should let them out on lease; thus, they had not the incentive of making profits by trading to improve compulsory purchase. No such restrictions were introduced into the Electric Lighting Act. He asked for no Government aid or favour for the new industry, but simply for fair dealing, and to let alone one of the most meritorious applications of science to the ordinary purposes of life, one that effected the solution of a problem which only a few years ago was declared to be insolvable—the division of the electric light in lamps supplied from a central source, and he did wish that such an industry as this should not be absolutely forbidden by an Act of this character. Further, undertakings such as the supply of gas, of water, or of electricity, were progressive; you started with a certain number of customers, and required a capital of, say, £20,000. The customers in the district gradually increased, and more capital would be wanted say at the end of five years; how were you to get it? If you tried to issue new shares, people would naturally say—"There are only sixteen years of your term remaining, and it is not worth our while to go into it." And if the company issued £100 shares, and only called up £20 at first, what right would it have at the end of 15 years to call up another £20, when there were only six years left in which to make it profitable. The whole thing was absolutely unworkable. Had there been any serious intention to promote electric lighting by this Act, it would have been better considered, but the evident intention was to stop it, and nothing but a strong expression of public opinion would get it reversed. When the Bill was passing through the committee, he sent a letter to the newspapers, headed "Something more than an Electric Lighting Bill," in which he pointed out that it introduced a new and vicious principle of turning local authorities into traders, and that it would not stop there, and it had not. The Corporation of Birmingham was applied to, to allow pipes to be laid down for conveying air under pressure for working small engines in factories, which was a healthy and useful mode of supplying power. His opinion on the scheme was asked by the Corporation, and he advised on various engineering details; when the Bill was drafted, he asked to see a copy, and to his astonishment found a clause that at the end of 21 years the Corporation were entitled to purchase the whole thing, not on the profits, but for the value of the materials "as a going concern," those words not being included in the Electric Lighting Act. Again, an application had been made this year for a bill referring to the distribution of water under pressure, in another town, and there again the same provision was inserted. The thing was growing, and if people did not come to their senses, and teach the Government that it was not the business of imperial or local government bodies to become traders, it would go on until all the business of bakers, butchers, shoemakers, and everything else would be in the hands of the mayor and corporation. He was sorry to have occupied so much time, but this matter really lay at the root of the want of progress in electric lighting. There were numbers of houses at the West-end where people would not burn gas in their sitting-rooms—he would not for one—and where they would willingly pay double the cost of candles or lamps for electric light. No one who had once enjoyed the comfort of this light, unless he were in dire need, would abandon it for a cheaper illuminant, until something

better, as well as cheaper, was invented. He would conclude by moving a hearty vote of thanks to Mr. Preece.

Mr. PREECE said he had not much to reply to, and he was pleased to find that the paper had not elicited much opposition. First, with regard to overhead wires he would say that if he were to live 50 years in Philadelphia he should never become satisfied with these overhead wires. They were hideous in the extreme, and the only advantage he had found for them was that they afforded a welcome shade from the fierce glare of the sun. But it was not necessary to go to America for them; in Brighton they were carried overhead, though not in the unsightly fashion which so disfigured the streets in the United States. In one place in New York he had counted 144 wires on one post, and in Broadway there were six distinct lines of posts going down the street, there being thirty-two separate companies in that city carrying wires on poles. There was no necessity for it at all, for it was found by the Post-office that, whenever the number of wires through a town exceeded fifteen, it was cheaper to put them underground than overhead; and he was quite certain that when the people in America came to their senses, this plan would be adopted. With regard to the meters, he thought the two cases Prof. Forbes had referred to must have occurred in the early days of the opening of the central station. There was no doubt that in the first twelve months considerable difficulties were experienced in the use of the meters, but now they had become more familiar these difficulties were avoided, and the meters were certainly working well. Meters on the same principle were also in use at Brighton, where there was a central station serving a great many places with the electric light; it was done in spite of this wretched Act of Parliament, and even without the consent of the Local Board. A gentleman in the room who was somewhat imbued with the American spirit, Mr. Hammond, went to Brighton and established a central station, from which he supplied the Grand Hotel, the Orleans Club, and many other places, in spite of the objectionable Act of Parliament and the Local Board, and he used meters on the same principle, to regulate his charges.

THE NATIONAL CONFERENCE OF ELECTRICIANS, PHILADELPHIA.

(Reported specially for the "Electrical Review.")

(Continued from page 430.)

PROF. SILVANUS P. THOMPSON (continuing): When everything is saturated no more magnetism can be imparted to the iron. The figures which Prof. Rowland mentioned for the maximum permeability were something like a thousand to two thousand, that is to say, in his experiments he found his ring-shaped iron cores to be one or two thousand times as permeable to magnetic induction as an equal volume of air would have been. These high figures have been surpassed in recent experiments made by Prof. Ewing in Scotland, who has given us figures going as high as five, ten, or fifteen thousand. But such numbers do not express in the least degree the facts concerning the iron cores of our dynamos. For practical purposes we want to know, not the number which expresses the maximum permeability that may under exceptional circumstances be given to some portion of iron, but the number which expresses the working permeability of our magnetic circuit as a whole. It is nothing like such high numbers; the figures we actually get are more like twenty or thirty than five thousand. It is true with respect to an iron bar, that by placing it in a coil, and subjecting it to very great magnetising forces, you may stuff it with magnetism from end to end, so that you can stuff no more magnetism into it; and in these circumstances, though some of the lines of magnetic force run through the bar from end to end, a great many of them do not run through from end to end but leak out at the sides. You may magnetise that iron through and through, and of course the central bit of the bar will have the greatest number of lines of force traversing it; in other words, it is possible that the central bit shall be so highly magnetised that there may be thousands of lines of magnetic force to every square centimetre of cross section. But we do not find this to be the case in the iron cores of our dynamos at those ends of the cores that are nearest to the place where the armature is being revolved.

Not long ago I was speaking with Prof. Hughes concerning his experiments on the multiplying effect due to putting an iron core into a coil. The experiments were tried in somewhat the same way as Prof. Rowland's in so far as an electric current circulating in a coil was used to magnetise an iron core, but the results were not the same. Prof. Hughes was using short iron bars, whilst Prof. Rowland used welded rings. Prof. Hughes took a coil, having simply a hole—or, in other words, a core of air—inside it. It was laid upon a board near an indicating magnetic needle, which turned when the current circulated round the core. At a certain distance along the board there was fixed a compensating magnet, which could be turned around a pivot by means of a handle until it counteracted the magnetic effect of the coil. The angle through which the compensator of this "magnetic balance" was turned measured the magnetic effect. Having observed the effect of the coil with its core of air, he then tried cores of iron of different kinds, and of steel, in order to see how many times the magnetic

effect was multiplied by using these substances as cores. When he put in an iron core of the softest Swedish iron he found, if I remember rightly, that it did not magnify the effect on the needle more than eight times. I do not mean that the permeability of the iron core was only eight, but that the permeability of the magnetic circuit through which the magnetic lines of force in this case had to run was only eight instead of five thousand or ten thousand. We want, before this subject can be considered completely, a great deal more of experimenting on magnetic circuits of which only a part consists of iron. It is a matter which can only be dealt with in an experimental way.

There is another matter that has not been dwelt upon: the effect upon the magnetic power of iron of the grain of the iron. I believe we are only beginning to realise the importance of employing wrought iron instead of cast iron in the building of dynamos. I may mention that Mr. Crompton, of England, who employs a dynamo of the type which has been so thoroughly abused to-day, has succeeded—without any other change beyond merely substituting for cast iron, wrought iron, having the same machine, the same armature, the same number of coils, everything alike except the quality of the iron—in getting an increase of 100 per cent. in the energy developed in the circuit of his dynamo. That is, it works as a machine of twice the capacity. He doubled the power of his machine by merely changing the quality of the iron. Now, we all know that it is easier to magnetise a bar of wrought iron according to its length than in any other direction; that is, to magnetise it along the grain. Try an experiment on a piece of wrought iron in which the grain can be observed, and you will find that it is far easier to magnetise it along the grain than across the grain. Try it, and you will realise the enormous importance there is in this question of grain. If we magnetise our iron so that our lines of magnetic force run with the grain of the iron, we shall get a higher degree of magnetisation internally because the iron is more permeable in along the grain than across it; and we shall get also a greater intensity in the external magnetic field—a higher value for H —and our electromotive force in the armature is proportional to that quantity. We ought so to arrange our dynamos that the lines of force should emerge from the iron into the air at points where there is end-grain in the iron. I should like to try the effect of constructing a dynamo, with single or double poles, so turned that the grain in the iron was directed in each pole to the place where the armature was to be; I believe it would give a better effect than if the grain were not thus directed.

In the book to which I just now referred, I have deduced a large number of equations for different types of dynamos; and of these I am going to trouble you with two simple ones because they bear upon this question of the quality and quantity of the iron in the dynamo. The two expressions which I am going to write out are those which I obtained for the electromotive force of a series-wound machine and for a shunt-wound machine respectively. The letters are the same in each case, except that s is used for the number of turns of wire in the series machine, and z for the number of turns in the shunt. R is the resistance of the external circuit; r_a that of the armature; r_m that of the series coil; r_s that of the shunt; n is the number of revolutions per second; λ is the armature co-efficient as explained previously; g is a certain geometrical coefficient depending upon the shape and size of the iron masses of the machine; it may be determined separately, but is never so required as it always goes along with k . k is the magnetic permeability, or that which Prof. Rowland has designated by π (see report of previous part of discussion, p. 368). My equations then are:—for the series machine,

$$E = \frac{1}{\sigma} \left(4 n \lambda g k - \frac{R + r_a + r_m}{s} \right)$$

and for the shunt machine,

$$E = \frac{1}{\sigma} \left(4 n \lambda g k - \frac{r_s r_a + R r_s + R r_a}{z R} \right).$$

You will notice that in both equations there comes in a certain factor $\frac{1}{\sigma}$. That factor comes in, as a matter of fact, into

the expression for the electromotive force of every dynamo, series, shunt, or compound, whether for the whole electromotive force in the armature or for that part of the electromotive force which appears as a difference of potentials at the terminals. It is of such immense importance that I will explain its meaning. I have taken k to represent, as I have said, the permeability of the magnetic circuit in the dynamo; and I am going to assume that the permeability does not rise to a maximum (as in fig. 9, p. 368, or fig. A, p. 430) in the ordinary kind of construction of a dynamo, as it does in one of Prof. Rowland's welded rings, or in the middle bit of a bar of pure iron. I assume that (as in fig. D, p. 430) it is constant for small currents, and then as the magnetising power is increased, gradually diminishes. I assume that fig. D, which shows the diminution, adequately represents the law of change. I then write, to represent this algebraically by writing, as the value of the permeability when the current has the strength of i and

circulates s times round the core, $\frac{k}{1 + \sigma s i}$, instead of simply k .

I do not say that this is the true law; but that it is one that practically meets the facts of the case most beautifully. Formule almost identical have been accepted as correct by no less authorities than Frölich, Deprez, Ayerton and Perry, and Clausius.

The coefficient, σ , which appears in this expression in front of the number of ampère-turns, is found to be in practice a small fraction. I call it the saturation-coefficient because it expresses the state of saturation. If the values of the current i are small, then $\sigma s i$ is small and k is virtually a constant. If i becomes large, then the second term of the denominator becomes of value relatively to 1, and the value of the permeability diminishes; k , the initial permeability, having now to be divided by a quantity perceptibly greater than unity. If i becomes very large, the value of k is still further cut down. If we multiply the above expression by i , the current, by s , the number of turns in the coil, and by the proper geometrical coefficient, g , we obtain a quantity which may be held to represent the average intensity of the magnetic-field: or

$$H = g s i \frac{k}{1 + \sigma s i}.$$

The intensity of the field is proportional to the permeability at starting (k), and also depends upon this saturation-coefficient, σ .

What is the quantity σ ? In examining what it means let us refer once more to fig. C (p. 430) representing the rise of magnetism, which we found might serve to represent also the "characteristic" curve, or curve of rise of electromotive force, provided the effects of the reactions due to self-induction, and the like, were so small that we might neglect them. The curve first rises obliquely, then turns over. If you would find out what σ means it means this: if that iron never got saturated, the magnetism would go on increasing as long as the current, or rather the number of ampère-turns increased. The oblique first part of the curve would go on indefinitely. But no, the oblique line turns round after a time, showing that the permeability of the iron is decreasing; and there comes a time, as shown in fig. E, at point P, when the magnet-

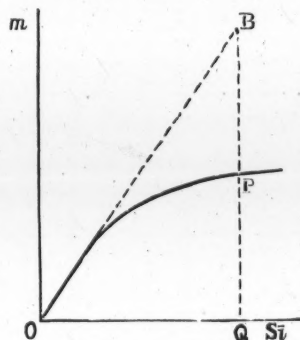


FIG. E.—CURVE OF SATURATION OF MAGNETISM.

ism is only one half what it ought to have been if the iron had remained unsaturated. Now this state of things occurs when there are a certain number of ampère-turns, namely that plotted out as o, q on the horizontal line. The iron of our magnet, when the current has that particular value, will have got so far saturated with magnetism that the permeability is only one half of what it was when we started.

To reach that point requires a very large number of ampère turns. The number of ampère turns which are required are the reciprocal of σ . I have calculated that a certain Edison-Hopkinson dynamo tested by Ensign Sprague required 20,880 ampère turns

to attain half-permeability. In that machine $\sigma = \frac{1}{20,880}$.

I find then, that other things being equal, the power of a dynamo is proportional to the number of ampère turns, which for practical purposes will reduce the iron to one-half its permeability. If, therefore, we have very good iron indeed, and plenty of it, so that to get it magnetised up to this critical point of saturation (or half-permeability) requires an enormous number of ampère turns, then we shall have a very large electromotive force when such iron is used. Here, of course, I deal with the permeability as a whole, not with the permeability only of the most permeable bit. There is another reason for thinking that Rowland's curve of permeability does not represent the whole truth and cannot be directly applied to our dynamos, and that is that in our dynamos we have to deal with iron which is not at one constant temperature. The permeability of the iron changes so much with the temperature, and is so different in different parts of the iron, that no theory of the dynamo can be complete that does not take that into account.

With this criticism then that Professor Rowland's curve of highest possible permeability, true as it is for its own circuit, is not true for such magnetic circuits as we have to deal with in dynamos, I shall dismiss this point.

In the earlier part of our president's introductory remarks he criticised the use of multiple magnetic circuits in the field magnets. Now I have more than once, in my published lectures, criticised adversely the use of multiple magnets attached to the same pole-piece; and up to a certain point I agree with our president; but for different reasons. There are certain machines (which I forbear to mention by name) in which there is an immense block of iron used as a pole-piece, having attached to them two or three parallel pillars of iron, separately magnetised, and connected at the back by another block of iron. These arrangements are scientifically

bad, not only for the reason Professor Rowland has named,—namely, that they require more wire wound around them than if the iron were in one solid piece,—but also for another reason. Let us look at the arrangement in plan. If all these three coils A,



FIG. F.

A, A, are going to magnetise the three cores so as to make the pole-piece a north pole, then the currents must circulate as shown by the arrows. Then in between the separate cores we shall have the current round the first core running up (see fig. F.) and the current round the second core running down. In between the two pillars or cores these currents are absolutely opposing each other's magnetising influence, and it would be better to wipe out these parts of the currents altogether. We therefore gain, by saving electric energy spent in overcoming useless resistance by running our two parallel cores into one, because then we shall not be employing part of our current to destroy what another part is doing in between the separate cores.

Moreover, we ought not to forget that mechanical considerations are quite as important as electrical ones. Take one case which our president put upon the board. He seemed to think that a single field-magnet such as he drew—like fig 3 (p. 351) only turned on its side—or like fig. 4 (p. 351) with the right hand half cut away—was better than fig. 4, in which there was an electro magnet

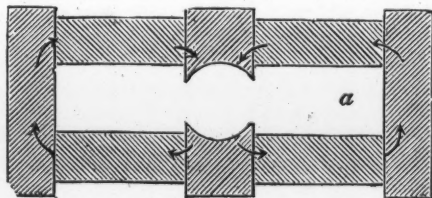


FIG. 4.

on the right as well as one on the left of the two pole-pieces. I do not agree with him. In the first place, if the right hand half of fig. 4 were used just as it is, the design is structurally bad, having a big piece of iron up in the air. If you turn it over as in fig. 3, with the poles at the bottom, then you short-circuit some of the magnetism through the bed-plate. If you turn it upside down—I believe our president drew it that way also, for I was struck with his use of that design to illustrate the leakage of the magnetic lines of force into the air—then it is also bad. I do not like an arrangement which has great masses of iron vibrating like a tuning-fork up in the air. I much prefer the arrangement of fig. 4 complete. In the second place, I do not like fig. 4 with one side removed, because it is not symmetrical bi-laterally with respect to the axial line which runs from the top pole-piece to the bottom pole-piece. If the form is symmetrically completed as in fig. 4, the two right-hand corners of the upper and lower pole-pieces will be magnetised symmetrically with the two left-hand corners. In the unsymmetrical machine you will not get equality of magnetisation unless, perhaps, you cut away the corners on the right or the left.

We had another drawing of a machine, in respect of which I quite agree with the criticism passed by our President. It is a machine which had one pole piece above, *b*, and one below, *d*, and two Gramme rings, *a* and *c*, one here and the other there, in between. (Fig. 8.) I have heard this machine called, I believe,

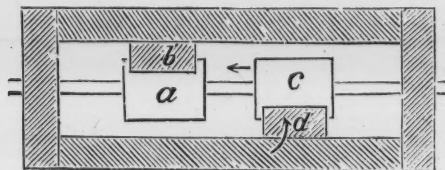


FIG. 8.

a "unipolar" (!) machine. It strikes me that it has *two* poles. I cannot help thinking that the design of that machine is altogether bad. It may work; the fact is it is hard to have a dynamo machine with a Gramme ring in it that does not work. But I have examined this machine in one respect; I tried to find out what was occurring in the vicinity of the armature in that part of the coil where we would naturally have expected the maker to place another pole-piece. I found this:—The current which was running through the armature and over the brushes to the commutator was inducing a pole in the armature, and that pole was in turn inducing a false pole in the piece of iron opposite it, where there ought to have been a real pole. As a consequence, by no

means all of the lines of force that ought to have gone across there did go across. They spread out into the air. I examined this machine once in England, and I saw a similar machine in your Exhibition. It seemed to me to be a striking commentary on the omission of the pole-piece, that over that machine alone, of all the machines in the Exhibition, there was a sign which ran:—"Do not approach this dynamo for fear of magnetising your watches." (Laughter and applause.)

I want, in conclusion, to refer to a curious point which no one has yet publicly stated anywhere, and of which no explanation has been given. Take a Gramme dynamo; here are the pole-pieces, *s* and *n*, and the armature is being run in the direction

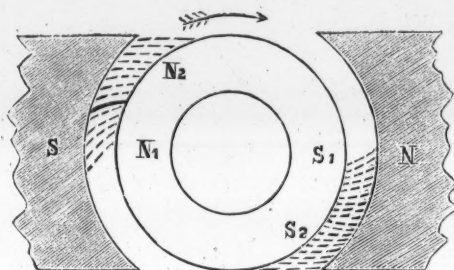


FIG. G.

indicated by the arrow. If no current is being taken from the machine, you will have induced poles in the ring at *n*₁ and *s*₁. If there are currents being taken from the armature and used in the external circuit, then owing to the magnetising effect of the armature current, the resultant induced poles will be shifted round to *n*₂ and *s*₂; they are the effective poles of the machine in action. I have shown elsewhere that the ratio of the two fields—that due to the current in the armature, and that due to the field magnet—is proportional to the sine of the angle of shifting. When these resultant poles are so disposed—and that is the actual way they are disposed—the pole is displaced forward, and strengthens the part of the magnetic-field immediately between the armature and the corner or "horn" of the pole piece marked *a* on the left and *b* on the right. The field is as a whole weakened by the reaction of the current in the armature, for the magnetic-field due to the current lies across that due to the field-magnets; but one effect is this strengthening of the field below the leading horn of the field-magnet, and another effect is a weakening of the field below the other horn. In a motor, the field due to the current in the armature strengthens that due to the external magnets, and the concentration of the field is reversed in position, the field being strongest beneath the horns *c* and *d*, and weakest beneath the leading horns, *a* and *b*. Now the effect I want to refer to is this:—In a Gramme machine which has been running for some time as a dynamo the leading horns or corners, *a* and *b*, get hot, whilst the corners *c* and *d* are comparatively cold. If the machine is used as a motor the reverse is the case, *c* and *d* get hot, whilst the leading horns, *a* and *b*, remain cold. In order to explain these facts, I am going to correlate with them another curious fact observed by Monsieur Cabanellas, and told to me by him when I was last in Paris. I have since been able to verify the fact. He took one of those beautiful laboratory-pattern Gramme machines made by Breguet, with steel magnets like a horse-shoe, and used it as a motor. After so using it for a while, he found the field-magnets going down in strength. After having spoiled it by this use he then used it as a generator, and found that the field-magnet recovered its magnetism and returned to nearly its original power. I thought this at first impossible; for the magnetic-fields respectively due to the field-magnet and the armature current absolutely help one another in a motor, and in a dynamo they oppose one another. I do not know how much they hinder one another in a dynamo; but to some effect the fields cross. There would be no electrical work done as work in the circuit if they did not. How can it then be that the helping field of the motor actually de-magnetises the magnet, and the working field of the dynamo absolutely helps to magnetise the magnet? And what connection is there between this observation of M. Cabanellas, and my observation about the heating of the corners of the pole pieces? To explain these facts and their mutual relation, I must narrate one other observation which I have made, and which connects both sets of facts. The observation is the following: I have not yet published the details, because I am going to try it with a larger number of magnets. I have only done it with two magnets as yet. Suppose you take a horse-shoe magnet, having the usual armature or "keeper" of iron. You can purchase such an instrument of any optician, who will probably give you instructions never to pull the armature off suddenly for fear you may injure the magnetism. He could not possibly give you worse directions. Take such a magnet and try what the effect really is. Fasten it down upon a board with brass screws, and fix a magnetometer near it—a common compass will answer—and notice how much the magnet pulls the needle around. Then put on the armature by placing it on at the bend of the magnet; draw it slowly to its usual position and suddenly drag it off. You will find that by this action your magnet will have

grown stronger. Do this twenty times and you will make it considerably stronger. I have made a magnet 1·2 per cent. stronger by putting on the armature very gently and pulling it off suddenly. If you reverse the operation by letting the armature slam suddenly against the poles, then drawing it along to the bend, and then detaching it gently, you will find that the magnetism will go down. I have made magnets lose 1·3 to 2·1 per cent. in this way. Why does this occur? How does it explain the two phenomena noticed just now? If you suddenly take away a piece of iron from a magnet you do work against the magnetic attraction, and the induced currents which are set up in the iron or steel of that magnet are always—as we know from Lenz's law—in such a direction as to oppose the motion; that is to say, they are in such a direction as will make the magnet pull more strongly than before. By suddenly detaching the armature we magnetise the magnet more strongly than before by means of currents circulating within its own mass and within the mass of the armature. In the reverse motion, when you allow the armature to slam up, there are induced currents which are in such a direction as to oppose the motion of slamming; they, therefore, decrease the magnetism of the magnet. Apply this to the dynamo and to the motor. You magnetise more highly by pulling off the armature. That is precisely what is occurring in the field (fig. G) when this machine is being used as a generator. You are dragging the armature away from the active horn, *a* (fig. G), of the pole, and the effect is to strengthen the magnetism of that pole, and also to generate induced currents in that horn. It, therefore, gets hot. So does the other leading horn, *b*, for the same reason. In the case of the motor the horns *c* and *d* are the active ones, and the armature is continually being dragged up toward them, and they get hot from internally induced currents. It is for this reason that in my Cantor lectures I recommended that pole pieces should always be laminated. The presence of these induced currents explains the heating effect, and it also explains how it is that when a magneto-machine is used as a motor the magnet is weakened, and when used as a generator the magnet is strengthened.

(To be continued.)

THE ORGANISATION OF THE POST AND TELEGRAPH SERVICE IN FRANCE.

(Continued from page 434.)

In a report, dated the 23rd October, 1880, we had the honour of stating to you in the following words, the reasons which appeared to us to call for the opening of an international electrical exhibition and of a congress of electricians:—

"Important and unexpected discoveries have recently, in a particular manner, called the public attention to all that refers to electricity; at the same time, the arts and manufactures, by making themselves master of those conquests of science, have for several years multiplied their applications in all their branches.

"No science, at the present time, more than the electrical science, appears to make such rapid progress, to solve problems concerning the economical life of nations and finally to render invaluable services to all our relations."

We added that the learned men and the manufacturers, in all countries of the world, at present seek to improve the means of producing and utilising this new force of electricity. The results, already obtained were considerable and numerous, but still incomplete and insufficient. It was of great interest to show precisely the state of the science and of its applications; to bring together and to compare the processes of researches, so as to give to the results obtained in all parts of the world a direction which might assure their success and render them fruitful.

You were kind enough to authorise, on my proposal, by a decree, dated the 23rd October, 1880, the organisation of the International Electrical Exhibition:—

At that time, the chambers were not sitting; as we did not wish to accept an expenditure, the amount of which had not been voted, we were obliged to have recourse to a guarantee association, the members of which engaged themselves to guarantee the expenses caused by the exhibition, to the amount of 500,000 francs, without sharing however in the profits which might result from the undertaking.

A committee of organisation, who fixed the general rules of the exhibition, a technical committee and a financial committee, composed for the greater part of the members of the committee of organisation, have lent a valuable co-operation to the administration; it has found in them assistants of indisputable value.

The interference of the State first limited itself to placing the "Palais de l'Industrie," free of cost, at the disposal of the guarantee association, and to place the exhibition under its patronage and supervision.

When the chambers met, a subvention of 200,000 francs was granted to the exhibition. A commissioner-general, Mr. George Berger, was charged with the administration of the exhibition, under the high direction of the Minister of Posts and Telegraphs. Germany, Austria, Belgium, Spain, the United States, Great Britain, Italy, Japan, Norway, Holland, Russia, and Sweden, were represented at it by special commissioners.

The exhibits were divided into six groups; 1. Production of electricity; 2. Transmission by electricity; 3. Electrometry; 4. Applications of electricity; 5. General mechanics; 6. Bibliography and history.

These six groups were sub-divided into 16 classes. 1,764 French or foreign exhibitors have taken part in the exhibition. According to their nationality, they were divided as follows:—France, 937; Germany, 148; Austria, 37; Belgium, 208; Denmark, 5; Spain, 23; England, 122; Hungary, 10; Italy, 81; Japan, 2; Norway, 19; Holland, 18; Russia, 38; Sweden, 23; Switzerland, 21.

It was only in the middle of the month of July that the "Palais de l'Industrie" could be handed over to us. This circumstance obliged us to put off for ten days the date first fixed upon for the opening, and it required very great exertions to have the installation completed on the 11th August, 1881, the day of the inauguration of the exhibition. You have been so kind as to honour it with your presence.

The electric lighting could not be commenced until sixteen days later. The "Palais de l'Industrie" was opened during the evening from the 27th August, 1881. The illumination by electricity produced a marvellous sight.

The evenings offered another attraction. Visitors crowded in the rooms where the telephones allowed of their hearing with great distinctness the songs or dialogues produced on the stages of the "Grand Opera," the "Opéra Comique," and the "Théâtre-Français."

The number of paid admissions amounted to 673,333.

The free admissions were of a considerable number. Cards had been liberally granted to schools, distributed in workshops, &c. The two last days were exclusively free; more than 80,000 persons made use of this power.

A total of nearly one million of visitors has gone over the Exhibition from the 11th August till the 20th November, 1881, the day of closing. These extreme dates were unfortunately forced upon us because of the "Palais de l'Industrie" being required for other purposes.

The receipts amounted to 1,050,000 francs, and produced a net receipt of over 330,000 francs. According to the terms of the agreement, signed by the guarantee association, the profits which the exhibition might yield were to be bestowed on a useful work, of such a nature as to contribute to the progress of electrical science. This association, therefore, has placed this sum at the disposal of the Government, to be applied for the creation of a special electrical laboratory.

By a decree, dated the 24th February, 1882, you authorised the creation of this laboratory, which will continue under more modest conditions the work of the congress. This electrical laboratory depends on the Department of Posts and Telegraphs, as being the most directly interested in the question, but it will be equally of use to the other ministerial departments.

Batteries, magneto-electric machines, the manufacture of submarine and underground cables, apparatus for electric measurements, railway signals, telephones, electric lighting, transmission of power by electricity, electro-physiology, galvanoplastics, the application of electricity to the regulating of time, have supplied an important contingent to the electrical exhibition.

Telegraph instruments took up a large space in it, and have shown the importance of the improvements introduced therein during the last years.

A jury, one half of which consisted of French members and the other of foreign members, selected from the most eminent men in the different countries, was charged to decide what rewards should be granted to the most deserving exhibitors. These rewards were awarded in a meeting held on the 21st October, 1881.

Besides five principal diplomas of honour, granted to the Telegraph Administrations of France, Germany, England, Austria, and Belgium, and 40 diplomas of honour received by different Administrations or learned societies, 8 diplomas of honour have been awarded to manufacturing establishments, and 11 to inventors. Among these we have to mention Mr. Baudot, engineer at the Ministry of Posts and Telegraphs, the inventor of the multiple instrument, which allows of transmitting simultaneously six messages printed in typographical letters. This is the instrument which at present works at the highest speed, and which seems to be the most perfect of all known telegraph instruments.

Moreover, nearly 500 gold, silver, and bronze medals were given to a corresponding number of manufacturers.

The Chambers thought that amongst the learned men whose co-operation assured the brilliant success of the exhibition and the congress, there were many whose devotedness and exertions could only be rewarded by honorary distinctions. A special law, in derogation to the law of the 25th July, 1873, allowed of rewarding, by promotions in the Legion of Honour, services rendered to the exhibition.

The same decree of the 23rd October, 1880, which authorised the organisation of the International Electrical Exhibition, decided that an International Congress of Electricians should be opened in Paris on the 15th September, 1881, under the presidency of the Minister of Posts and Telegraphs, and that three vice-presidents should be selected from amongst the French members, and three from amongst the foreign members of the congress. The greater part of the different countries have sent us their most eminent learned men.

The congress which met on the date mentioned divided itself into three sections, with the intention of studying more particularly: the first one, the questions of physics, chemistry, physiology, and electricity generally, from a theoretical point of view; the second one, the questions referring to telegraphy and railways; and, the third one, the other civil or military applications of electricity.

The principal work of the congress, from a point of view of pure science, has been the adoption of a system of electrical units,

accepted by the learned men of all countries. The power of a source of electricity, the resistance which different materials offer to the propagation of electricity, finally the intensity itself of an electric current are as many measures which it is indispensable to value in a precise manner when one wishes to compare the different apparatus at present in use.

The measures, however, used in different countries to indicate this power, this resistance, this intensity, were not uniform. Under the same name as many different values were designated as in former times; there were feet, pounds, quintals, bushels, before the establishing of the metrical system.

When going from one country into another one had to change the dictionary, and in order to make the apparatus of two countries agree which entered into telegraphic communication, one had to give one's self up to long and difficult calculations.

The congress, after many learned discussions, and by adopting as basis the works and discoveries of the eminent natural philosophers of our century, has established a system of electric measures, properly arranged, bringing all the manifestations of electric power home to a common measure, connected with the metrical system, not leaving room for any misunderstanding, and which can be expressed in plain and precise words. It has given to the different electrical units the names of Coulomb, Volta, Ampère, Ohm, Faraday, i.e., those of the learned men whose discoveries have caused the greatest progress to be made in electrical science.

The congress has also expressed the wish that the French Government should invite the other governments to appoint international committees to consider and to settle the following questions:—

1. The determination of a practical standard of electrical resistance.
2. The use of telegraphs for meteorology and the relation of this with atmospheric and terrestrial electricity.
3. The determination of a standard of light.
4. The protection to be given to submarine cables, which for want of assent by the international laws, are without protection against deteriorations resulting either from imprudence or from ill-will.

Besides these important questions, the application of medicine to physiology, the problem of the protection of buildings against the effects of lightning, the amalgamation of the different measures relating to submarine cables, were successively the subject of interesting discussions at the congress.

With the aid of the exhibition, of which the congress could avail itself, like an immense laboratory, it has given great publicity to the discoveries of the learned men. It will mark an important date in the history of electricity.

(To be continued.)

PRACTICAL TESTING OF AN ACCUMULATOR SYSTEM DURING CHARGING.

By PAGET HIGGS, LL.D., D.Sc.

IT is frequently of advantage to know, in the earlier period of charging a series of accumulators, that the internal resistance of the latter has suffered no change during, say, a previous period of rest or in first installation. Indeed, in the working of installations from gas engines, I always instruct that a daily test be made and recorded, and I find in the record an extremely valuable collection of facts relating to the behaviour of accumulators; the test occupies but a minute or two, and assumes the possession of only the voltmeter and ammeter that *should* be adjuncts to every dynamo-machine.

We know that the current in charging a series of accumulators is

$$C = \frac{E - e}{R}$$

e being the contrary E.M.F., and whence

$$R = \frac{E - e}{C} \quad (1)$$

Now, suppose that we increase E for a few moments, by increasing the speed of the engine [or by passing the main current through a few coils of wire properly wound outside the usual (shunt) magnet coils by unplugging a short circuit pin]. In cases where gas engines are employed, or separate steam engines, the hand or a large washer laid on the governor suffices. We then have

$$R = \frac{E + \epsilon - e}{C + c} \quad (2)$$

From (1) and (2)

$$e = E - \frac{\epsilon C}{c},$$

or the contrary E.M.F. is obtained without disconnection of the leads or stoppage of work; and

$$R = \frac{\epsilon}{c}.$$

Of course the resistances of machine and leads are known, and we may now easily obtain the resistance of the accumulators.

Suppose, for example, that in normal running E is 60 volts to which corresponds, say, 20 amperes for C .

Increasing the speed gives, say, 62 volts, whence $\epsilon = 2$ volts; and to this corresponds $(C + c) = 25$ amperes, whence $c = 5$. From this we learn that the contrary E.M.F. is

$$e = 60 - \frac{2 \times 20}{5} = 60 - 8 = 52 \text{ volts; and}$$

$$R = \frac{\epsilon}{c} = \frac{2}{5} = 0.4 \text{ ohm.}$$

Thus can be exactly checked whether the accumulators are in good working order, and in a few moments.

NOTES.

Electric Lighting.—The new installation of the electric light at the Royal Courts of Justice was inaugurated on Monday, and the whole of the lights were kept running until the rising of the judges. The site of the plant is the vaulted basement beneath the Great Hall, in which also is placed the ventilating and warming apparatus for the vast pile of buildings. The electrical plant consists of two single cylinder Galloway engines, each capable of indicating 110 horse-power, and supplied with steam from two fine Lancashire boilers. The dynamos are of the Crompton-Bürgin type, self-exciting, and eight in number. One engine and one boiler only are employed in the lighting service; the other engine and boiler being in reserve, as is also one of the dynamos. Two of these machines are employed on the six Crompton arc lights which illuminate the Great Hall, and the other five supply current to the 600 glow lamps which light the various courts and corridors. The engine runs at 75 revolutions, with a 2-ft. 6-in. stroke in a 20-in. cylinder, and is furnished with a large and heavy fly-wheel, which drives on to the main pulley of the counter-shaft by a link belt 21 in. wide. A very ingenious clutch arrangement is adopted by which either engine can be at rest without exercising any friction on the counter-shafting. Each boiler is constructed to endure a daily working pressure of 100 lbs. to the square inch. The dynamos are driven off the counter-shaft also by link belting. They are run at about 1,500 revolutions per minute, and give off 110 amperes current with an electromotive force of 85 volts. The incandescent lights are of 20-candle power each, are arranged in parallel, and by an adjustment effected at the switch-board the variation in their requirements is perfectly regulated. The arc lights are of 2,000 actual candle power each. The power of the one engine employed upon the present installation is sufficiently ample to allow of a considerable addition to the lighting being made when required. All does not yet, however, appear to be right, for the *Times* of Wednesday contained the following dismal story:—"The reinstatement of the electric light has been anxiously expected by every one connected with the courts, for the *ad interim* arrangements for lighting them have been of a very feeble character, and it has lately been at times almost impossible to see either to read or to write. This afternoon, however, Court No. 4 has been in worse plight than ever, for after the electric

light (the installation of which was supposed to have been completed yesterday) had been turned on, though it burned brightly enough at first, in a very few minutes, after getting gradually dimmer, it expired altogether, and there was nothing to meet the emergency, for the scanty supply of candles and lamps which have hitherto been forthcoming did not make their appearance, and on inquiry it turned out that all the candles had been withdrawn, and that none of the lamps had been trimmed, presumably in reliance on the electric light. The consequence was that the learned Judge had perforce to rise shortly before the usual time, and great difficulty was experienced in making up to-morrow's paper for want of light to read the list."

The Court of Common Council of the City of London last week resolved, at the instance of the General Purposes Committee, to enter into an agreement with the Hammond Electric Light and Power Company, Limited, for lighting the Mansion House with the electric light for twelve months, for £1,000.

The current for lighting the Society of Arts has until recently been obtained from a dynamo worked direct from a gas engine, and the fluctuation in the lights has been very perceptible. Last week the Electrical Power Storage Company put in a set of cells to act as a regulator. During Mr. Preece's lecture on Wednesday evening (last week) the large hall was lit from the gas engine and dynamo, with the cells on a *shunt*, and the lights were absolutely steady.

The new paddle steamer *Lucinda*, which has just been completed for the Queensland Government by Messrs. Wm. Denny and Bros., Dumbarton, is a fine specimen of a Clyde-built ship of the river passenger type. Though designated a lighthouse tender, the *Lucinda* is practically a splendidly-upholstered and finely-equipped steamer. She is built of steel throughout, and her dimensions are:—Length, 180 feet; breadth, 25 feet; depth, 9½ feet. Her chief compartments are two dining saloons, a social hall, smoking-room and ladies' boudoir. A complete installation of the electric light is fitted in the *Lucinda*.

The new United States cruisers are to be lighted by electricity, we learn. The electric plant for incandescent lighting supplied to the *Trenton*, beyond some slight defects in the insulation of the wires which could not have been anticipated, has given great satisfaction, and has added materially to the comfort and health of the officers and crew. The plant for the *Atlanta* is to be supplied by the United States Electric Lighting Company of New York; that for the *Boston* by the Brush Electric Company of Cleveland, and that for the *Omaha* by the Consolidated Electric Light Company of New York. In these vessels the defects referred to in the wiring of the *Trenton* will be remedied.

Messrs. W. T. Henley & Co. inform us that they have been awarded a bronze medal by the International Health Exhibition, for their electric light cables. We understand that not a single fault occurred in any of the firm's cables during the whole time of the exhibition.

On several occasions we have referred to the electric lighting of the new public library at Leeds as being amongst the successful installations in the kingdom. Messrs. Paterson and Cooper, the contractors, received some time since the following letter, which they need no longer treat as private:—"Gentlemen,—I have been requested by your representative, Mr. Wallis, to give my opinion on the system of lighting by electricity in the new public library in this town. I have great pleasure in saying that during the four months we have occupied the premises the light has been a success. We have been solely dependent upon the electric light in all three departments, the news room, lending library, and reference library. Both the staff and the public are evidently pleased with the change from the system of lighting by gas, as in the old library premises, and with the coolness of the atmosphere and the

better light given.—Yours faithfully, James Yates, Public Librarian, Leeds."

The first number of *Plumbing and Decorating* contains an article on "The Electric Light with Reference to Decoration," and a number of artistic designs for lamp fittings, &c.

We understand that Messrs. Paterson and Cooper have secured the contract for wiring the Grosvenor Gallery; Messrs. Faraday and Son will be responsible for designing and supplying the electric light fittings, and Marshall and Sons will provide engine power. It is probable that "Sun" lamps will be employed for illuminating the picture gallery proper.

Telephone Call Offices.—The National Telephone Company has resolved to open call offices in Aberdeen, where any person may converse with a subscriber within a radius of six miles on payment of three-pence for three minutes, and one penny for every additional minute. Branch exchanges at Inverurie, Stonehaven, and other towns in the neighbourhood, are contemplated.

Increased Telephonic Facilities in Edinburgh.—An arrangement has been made whereby any member of the public may, on payment of a small fee for a brief conversation, have telephonic communication at three different centres (one of the number being Parliament House) with any subscriber to the Edinburgh and Leith Telephone Exchange.

The Telephone in Italy.—The table given below shows the great development of the telephone industry in Italy, and the brilliant future which is in store for it.

CITIES.	Number of Subscribers.		Increase.
	On August 30th, 1883.	On August 30th, 1884.	
Turin	577	1,140	563
Milan	520	1,087	567
Genoa	515	828	313
Florence	521	742	221
Bologna	318	436	118
Leghorn	240	317	77
Rome	923	1,351	428
Naples	539	641	102
Venice	185	190	5
Palermo	253	333	80
Messina	113	124	11
Catania	130	181	51
Totals	4,834	7,370	2,536

This statement is only made up to August, 1884. It should be observed that in the cities of Turin, Milan, Genoa, Florence and Bologna, amalgamations have been made during the current year with competing companies; the increase in the number of subscribers in these localities is none the less remarkable.—*La Lumière Electrique*.

Extension of the Telephonic System in the Northern Counties.—At a special meeting of the Lancashire and Cheshire Telephonic Exchange Company, at Manchester, it was announced that under the new agreement made with the Post Office authorities the business would be extended by opening the call offices in various parts of Manchester and Liverpool and on the railway stations within the district, establishing communication between the principal towns of Lancashire, Cheshire, and Yorkshire by means of trunk lines, the opening of offices for domestic subscribers in several portions of Manchester, Liverpool, and other towns. Arrangements were also being made by which subscribers could receive and despatch telegrams by means of the telephone; the only restrictions now being that a royalty of 10 per cent. be paid on exchange business, and that there be no competition with the telegraph service.

Telephone Communication in Scotland.—Several coalmasters have arranged with the National Telephone Company to open an exchange in Hamilton for communication with Glasgow, and the county and burgh road authorities have been arranged with for permission to set down posts on which to carry the wires. By the payment of a fee of 6d. per conversation of five minutes, the public are also to be allowed to go to the exchange and speak to subscribers of the company in Glasgow. Arrangements have also been made in other towns for the use of the telephone for short periods by the public.

The Telephone at the Aberdeen Industrial Exhibition.—The National Telephone Company, Limited, exhibited at the Industrial and Art Exhibition, held during the present week at Aberdeen, a complete telephone exchange in connection with the Aberdeen exchange system, and opened an office for the transmission of messages from the public to any subscriber on payment of a small fee.

Telephone Patent Cases.—Mr. J. J. Storrow, counsel for the American Bell Telephone Company, left New York for Europe on Friday, November 7th. It is said to be not unlikely that his journey is connected with the litigation now threatening between the United Telephone Company and the new company owning the Valve telephone. The latter was the subject of a question in the House of Commons last week, when Mr. Shaw-Lefevre, in reply to Mr. Kenny as to the merits of the Gower-Bell and the Valve telephone, said that the Patent Office had obtained additional information, but it was not yet open to the inspection of the public.

Telegraphic Communication with West Africa.—The India Rubber, Gutta Percha, and Telegraph Works Company has received a telegram from its engineer, Mr. Robert Kaye Gray, announcing the completion of the Spanish National Telegraph Company's cable between Teneriffe and the French West African Colony, Senegal, by which the latter is put into communication with Europe through the same company's existing cable from Cadiz to Teneriffe.

English and Foreign Telegraphs.—*The Financial News* compares the relative freedom with which the telegraph is used in this and other countries. America, it says, is emphatically the land of telegrams, for the 12,917 telegraph offices of the United States despatched last year 40,581,177 messages. The offices in the United Kingdom, however, show a much larger proportion of messages, since our 5,747 telegraph stations despatched during the year 32,934,029 "wires." Germany, which possesses nearly double the British total of offices—10,803 is the exact number—sent out only 28,362,173 messages. The fourth place on the list is occupied by France, which, with 6,319 telegraph offices last year, sent out 26,260,124 telegrams. Then come Russia with 2,819 offices and 9,800,201 messages; Italy, with 2,590 offices and 7,026,288 telegrams; Austria, with 2,696 stations and 6,626,203 messages. Belgium, with the very small number of 835 stations, shows the relatively large total of 4,066,843 messages. Switzerland sent 3,046,182 telegrams during the year. Spain, behind the times in everything, comes at the bottom of the European list, with 647 telegraph stations and 2,830,168 telegrams.

The Telegraph in the Soudan.—A telegram from Alexandria, on December 8th, states that Mr. Floyer, the inspector-general of telegraphs, has successfully spanned the river Nile at Assouan, with three specially made steel wires, which are suspended from high masts erected on the mountains on either side of the cataract. The distance spanned—seven thousand feet—is believed to be the longest on record.

Telegraphic Concessions to Greenock.—For a considerable time past there have been numerous complaints as to the delay in the transmission of telegrams between London and Greenock, these delays being a cause of great inconvenience to merchants as well as to the local press. With a view to having the grievance complained of remedied, the Chamber of Commerce requested Mr. Crum, M.P., to ask in parliament for a return of the interruptions which had occurred during six months. Mr. Crum thought it better to bring the matter under the notice of Mr. Blackwood, the permanent secretary of the post office, and that gentleman acknowledged the justice of the complaint, and without loss of time had the grievance remedied. We understand that a new wire has been set apart for Greenock messages, and that during the few days it has been in operation its working has been all that could be desired.

Extension of the Central Telegraph Office.—The additional story which has been in course of erection for the past two years at the General Post Office West has now been completed. About three years ago the growth of telegraph business necessitated the provision of additional space for the central telegraph office in London. After various plans had been considered, the First Commissioner of Works—Mr. Shaw-Lefevre—in consultation with the late Postmaster-General, decided to make the necessary provision by the erection of a fourth story instead of seeking to remove the office to another part of the city. The contract for building the new storey was given to Messrs. Mowlem, by whom it has been carried out in a satisfactory manner without interfering with the business which has been carried on in the instrument rooms immediately below. A portion of the new story was brought into use for instrument purposes last Easter, and the remainder was occupied last week. The additional space is used for 381 circuits, connecting the central office with metropolitan and suburban offices. Five hundred telegraphists, most of whom are women, are employed from 8 a.m. to 8 p.m. to work these circuits. The third floor will be devoted to provincial circuits—351 in number; and in the course of the next few months the pneumatic tubes connecting the principal branch offices in the eastern central district, &c., with the central office, will be removed to the large hall on the ground floor. The two top floors of the building will then be used solely for instrument work. The Postmaster-General went over the central telegraph office last week, and expressed himself as much satisfied with the new story and with the arrangements which have been made for carrying on the work there.

Press Telegrams.—Mr. Ecroyd asked the Postmaster-General, in the House of Commons on Thursday, last week, whether during the past few months an extra charge had been imposed upon newspaper proprietors in certain towns for the receipt of Press messages after the ordinary hours during which the telegraph offices in the towns were open to the public; and whether such charge was not precluded by 31 and 32 Vic., c. 101, section 16. Mr. Shaw-Lefevre: It is the case that within the last few months the proprietors of the newspapers at Bolton and Preston have been required to pay the cost of late attendance for the receipt of news; and this is in accordance with the usual practice elsewhere. The charge is not contrary to the Act quoted by the hon. member.

The "Faraday."—The Nant Gwynant, steamer, which arrived at Liverpool on Wednesday last week, from Newport News, reported that on November 23, in latitude 43°30' N. and longitude 50° W., she spoke the Faraday, telegraph cable steamer, heading W.N.W. She also reports that she saw several buoys with flags on them a short distance from her, and that she put up the following signals:—"P.Q.G.—report me to my owner."

The Union Electric Light and Power Company, Limited.—A petition asking that the voluntary winding up of this company might be continued subject to the supervision of the Court, was heard by Mr. Justice Pearson this week. The company was registered on the 3rd of April, 1882, with a nominal capital of £25,000 in shares of £100 each, which was afterwards increased to £30,000 by the creation of 50 new shares. In August last, the company resolved on a voluntary winding up, and appointed the then directors—Mr. Dillwyn Parrish, Mr. Alfred Parrish, Mr. John Goddard, jun., and Mr. James Fyfe—to be liquidators. The petition was presented by the liquidators. There was also a summons by Mr. Andrew Hutton, a holder of 10 shares, asking for the removal of the liquidators, and that Mr. H. Newson Smith, an accountant might be appointed liquidator. This application was supported by a Mr. Edmondston and other shareholders holding capital in the company to the amount of £4,400. Mr. Justice Pearson said that no one objected to a supervision order. But it was objected by the summons of Mr. Hutton and some other shareholders, who held among them about one-fifth of the share capital of the company, that the gentlemen who had been appointed liquidators were not, under the circumstances, proper persons to fill that office, and that, at all events, some of them ought to be removed, and independent liquidators appointed in their place. It was pointed out that all the four gentlemen had been directors of the company, that three of them had been promoters, and that Mr. Fyfe was the vendor of some patents to the company, and it did seem to his Lordship at first, that, if any alteration was to be made, all the four liquidators should be removed. To his mind it seemed that it would be very inconvenient and a source of great expense to appoint different liquidators to represent different interests. One of the principal charges made against the directors was that there were some irregularities in a sale which took place in May, 1882, of the company's patents to the Pilsen-Joel Company, for £15,000 in cash and 12,000 fully paid up £5 shares and in the disposition of the proceeds of sale. But *ex concessis* £35 per share had been returned to the shareholders. It was said that the shares of the Pilsen-Joel Company might have been sold when they were at a premium of £4 per share and that if this had been done a large profit would have resulted to the company, and it was alleged that the directors had postponed selling the shares with a view to private gains of their own. This charge, however, was made on mere suspicion, without any evidence, and his Lordship dismissed it entirely from his consideration. He thought he should be going beyond the provisions of section 141 of the Companies Act, 1862, and beyond the decided cases, if he were to say that any "due cause" had been shown for the removal of the liquidators. He therefore dismissed the summons with costs, and he made a supervision order.

Incandescent Lamps.—Messrs. Woodhouse and Rawson write to us as follows:—"We find that certain people have been making incandescent lamps looking, in external appearance, like ours, with the exception that the finish is not so good, and have been selling them as ours at a low price. We would be much obliged if you would notice this in your next issue, calling people's attention to the fraud, as, of course, it is doing us much damage, besides being excessively disappointing to the purchasers of the lamps."

King, Mendham & Co.—The largest and most complete catalogue of electrical apparatus we have ever seen is that just published by Messrs. King, Mendham & Co., of Bristol. It contains descriptions of batteries, and all kinds of experimental apparatus, whilst parts of apparatus for amateur's use, and a wire table giving the resistance and weight of copper and German silver wires, form special features; at the end information is given as to electrical terms, proper arrangement of batteries, and formulæ for winding bobbins, &c.

Killed by Electricity.—The *Mechanical World*, in commenting on the unfortunate case of death by electricity at Messrs. Bolckow, Vaughan and Company's Eston Works, says: "The evidence showed that the deceased and other employes had been cautioned not to touch the wires. The matter, however, is too serious a one to be passed over lightly, for no amount of cautions given will prevent the average workmen in such places from sooner or later neglecting them. So far as the published evidence shows, danger of the most serious kind exists in this particular installation, for it was proved that the unfortunate man touched the lamp with one hand only, and that therefore the insulation was enormously defective, or that an earth return was used. In either case the danger is an avoidable one, and it is highly probable that the defective arrangement which appears to have been the cause of the man's death was made with an economical intent. We should be greatly relieved to find that the ordinary precautions dictated by experience were observed in this case, and that the accident was merely regrettable."

The Lighthouse Experiments at South Foreland.—Mr. J. S. Webb, Deputy Master of Trinity House, writes to *The Times*:—"Observations on the experimental lights shown from South Foreland have now been going on for more than eight months, and the Elder Brethren of the Trinity House feel assured that by this time a vast mass of most valuable evidence must have been put on record in respect of the merits in all kinds of weather of the several illuminants and burners which have been under trial. It is therefore in contemplation to suspend the experiments at South Foreland, and to call in the observation books, which have been widely distributed. But before proceeding to examine the evidence in detail with a view to reporting generally on the whole investigation, my colleagues think there may be some members of the general public, and of the shipping community also, who take an interest in the question, and who, having their own views in regard to the competition, might be glad of an opportunity of expressing their opinions on the subject. To all such, I, as chairman of the special committee appointed to deal with this subject, wish to say that the Elder Brethren will gladly receive and give their best consideration to any representation which may be addressed to them at this House, either in regard to the illuminants or burners, or to their method of carrying out this most important inquiry."

The Theft of Electric Light Fittings.—When Henry Sport, 39, and W. Harkworth, 34, surrendered to their bail on the charge of being concerned with a man named Knox, absconded, in stealing a large quantity of metal fittings from the works of the Anglo-American Brush Electric Light Company, Belvedere Road, Lambeth, they said they knew nothing about the metal. They met Knox as they were returning from their work, and he asked them to assist him in carrying the basket. Sergeant Ward said that since the prisoners had been arrested he had made inquiries about them, and ascertained that they were respectable men, and bore excellent characters. As for Knox, the actual thief, he had left the country. Mr. Bridge ordered the prisoners to enter into recognizances to appear when called upon.

International Inventions Exhibition.—The applications for space have now all been examined by sub-committees of the council, and a selection has been made of the most promising. It will be a difficult matter to accommodate those which have been selected, and it is feared that the list will have to be still further reduced. The guarantee fund now amounts to £48,280, a sum considerably in excess of that subscribed for the Health Exhibition, or for the Fisheries, the amount for the former being £26,518, and that for the latter £26,656.—*Journal of the Society of Arts.*

Gas Explosion in the City.—Gas explosions are becoming numerous. One afternoon last week an explosion occurred at the establishment of Mr. E. Wood, optician, &c., 74, Cheapside. The shop was filled with smoke and the *débris* of broken fittings, and two workmen were thrown off their seats. The police entered the establishment and rescued the two men, who were placed in cabs and taken to St. Bartholomew's Hospital. It was then found that they had been severely injured, their clothing having been literally burnt off them. They were unable to give any explanation of the cause of the accident, but both stated that the gas had not been interfered with. The force of the explosion blew out the whole of the plate-glass window.

Dr. Davy's Claims.—From *The Melbourne Argus* we learn that a deputation from the Royal Society of Victoria waited upon the Premier on August 27th with the view of urging the claims of Dr. Davy as an inventor of the electric telegraph on the attention of the Government. Dr. Davy has been 40 years in the colony, and during the greater part of it has been settled at Malmesbury as a medical practitioner. He is now nearly 80 years of age. His health and strength are failing, and he is not in the best of circumstances. The Royal Society, therefore, thought it advisable to bring his claims under the notice of the Premier. The first request of the deputation was that the Premier would take such steps as he might deem fit to obtain recognition of Dr. Davy's claims from the Home Government by placing his name on the civil list; and the second, that he would ask the Victorian Parliament for a grant in recognition of Dr. Davy's claims. A subscription list had been started by the Royal Society, and any proceeds from it could go towards increasing the amounts which might be otherwise obtained. Mr. Service said he would send to the agent-general in England, and request him to do what he could to bring the matter before the English Royal Society. The best plan at present would be to give Dr. Davy a small sum for one year, and it might afterwards be decided what final mode of recognising the claims should be adopted. Mr. Bosisto could move in the Legislative Assembly for £100 to be placed on the estimates this year for Dr. Davy, and the Government would support the motion.

The Coming "Force."—This is the heading of a short article in *Punch*, complimentary to what appears to be the Fyfe-Main system of electric lighting. Says our bright contemporary:—"A *propos* of the question of economy involved in the employment of the electric light for all purposes of out-door illumination, the chief of the police of New York has gone as far as to say that "every light erected means a policeman removed." Coming from such a quarter this is a valuable contribution to the discussion, and the reflective wayfarer has merely got on a fairly dark evening to attempt his passage on foot along some of the less frequented bye-streets of any of the metropolitan suburbs, to realise, very possibly, with the sudden and unexpected assistance of the local burglar's bludgeon, the full force of the statement. Yet this is the nineteenth century, and the most prejudiced holder of gas shares, who passes one of the private electric lights that shed their nightly lustre in the Strand, cannot help literally seeing for himself that something little short of a day-lit London is now only a question of time. It would indeed be a gain to the suburban Londoner not only to see his way home in safety, but also to have the additional satisfaction of knowing that the units of the new, unlike those of the old police force, would invariably be found when wanted doing their duty at their respective posts.

New Patent Journal.—The first number of the illustrated *Journal of Patented Inventions*, which the Comptroller of Patents was directed by the Act passed last session to publish, appeared last week.

Overhead Wires.—Sir Charles Dilke attended Tuesday's meeting of the Chelsea vestry, of which he is a member, and authorised a statement to be made with reference to overhead wires. The vestry of St. George's (Hanover-square) had addressed to the Local Government Board a memorial urging that board to bring the erection and maintenance of overhead wires under due control by some adequate local authority, and expressed the hope that Chelsea would concur with them in the matter and adopt a similar course. Sir Charles gave the Hon. Conrad Dillon permission to mention "that the Local Government Board were pledged to move for a committee on the subject of overhead wires, and it was hoped that, on the report of that committee, a bill would be brought in by the government early next session."

Lectures at the Royal Institute.—The Christmas course of lectures adapted to a juvenile auditory will be given by Prof. Tyndall on "The Sources of Electricity,"—friction-electricity, volta-electricity, pyro-electricity, thermo-electricity, magneto-electricity, with numerous experiments. The first lecture will be delivered on December 27th.

Brighton Electric Railway.—During a terrific gale which raged at Brighton on the 4th inst. the electric railway was undermined in several places and carried away.

Enterprise.—Messrs. Duncan Brothers, engineers, of 32, Queen Victoria Street, have favoured us with the first number of their monthly illustrated list of new machinery.

Obituary.—We regret to announce the death, at Paris, at the age of seventy-four, of M. Quet, a distinguished French mathematician, well known for his works in connection with capillarity, electricity, &c.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Crossley Telephone Company, Limited.—The statutory return of this company, made up to the 25th ult., was filed on the 2nd inst. The nominal capital of £100,000 is divided into 5,000 A, 12,500 B, and 2,500 C shares of £5 each. 607 A and 350 C shares have been taken up, and the full amount has been called and paid thereon. Registered office: Albany Buildings, Bradford.

Great Western Electric Light and Power Company, Limited.—An agreement dated 4th inst. has been filed with the registered documents of this company, and authorises the allotment to Mr. Hy. Threlkeld Edwards, the official liquidator of the Devon and Cornwall Electric Light and Power Company, Limited, 3,000 fully paid up ordinary shares in the Great Western Company.

An agreement, dated 16th of June, was also filed on the 4th inst. This document provides for the surrender by the Great Western Company of 1,500 fully paid up shares and 500 ordinary shares with £2 10s. paid up, allotted by the Devon and Cornwall Company. In consideration of such surrender and the allotment of the 3,000 shares above referred to, Mr. Edwards agrees to withdraw his claim of £24,946 16s. 11d. against the Great Western Company, and any other claim he may have as official liquidator, in respect of the alleged misrepresentation as to the Lane-Fox patents or other matters.

Elwell-Parker, Limited.—The registered office of this company is at Commercial Road Works, Commercial Road, Wolverhampton.

CITY NOTES, REPORTS, MEETINGS, &c.

Swan United Electric Light Company, Limited.

THE second ordinary general meeting of this company was held at the Guildhall Tavern, Gresham Street, E.C., on Tuesday, Mr. J. S. Forbes, the Chairman of the company, presiding, when the following report was submitted:—

"In presenting their second annual report and accounts, the directors beg to refer the shareholders to the report of the Edison and Swan Company, which has already been circulated among them, for information on the working of the English portion of the business. Although, in consequence of the exceptional circumstances hereafter alluded to, the directors are unable to show a profit on the year's working of the foreign business, yet, from the fact that the sales of lamps have more than doubled during the period, they believe the lamp business will ultimately develop into a valuable property.

"In the accounts presented with their last report, the small factory which had been established in Paris by the former owners of the foreign patents showed a loss of £1,470 9s. 6d., as the whole of the proceeds of the foreign business, excepting that of France, had been carried to the credit of the English business, and were, at the time of the separation, handed over to the Edison and Swan Company.

"On the expiration of the lease of the Paris factory, larger premises suitable for a more extended manufacture were taken at Lille, but, unfortunately, a few weeks before the new factory got into full work the principal portion was destroyed by fire.

"The Patent Convention, which came into operation soon afterwards, enabled the company to import lamps into France without violating their patents, and an arrangement was effected with the Edison and Swan Company, under which that company agreed to supply lamps for foreign sale until the reconstruction of the Lille factory. As in a special manufacture of this kind considerable time and money are necessarily expended in training a working staff, it was inexpedient to dismiss the hands that had been already trained, and a further loss was therefore entailed by the payment of wages during the period of forced inaction.

"Though the rebuilding of the factory is not yet completed, the manufacture of lamps on a moderate scale has been resumed, and there is every reason to hope that the large arrears of orders which have accumulated will soon be cleared off.

"The rapidly growing demand for electric lighting on the Continent, referred to in the last annual report, has continued, and your directors, having already established agencies in France, Austro-Hungary, and Germany, are now negotiating for similar agencies in other countries. At present your directors consider that their attention should be directed chiefly to the manufacture and sale of lamps and electrical appliances, leaving the work of installation principally to local enterprise.

"Your directors are establishing a second factory at Cologne, a step which was rendered necessary by the provisions of the German Patent Law, which make obligatory the introduction of a substantial manufacture within a certain time after the granting of a patent.

"Of the £4,000 mentioned in the last report as shortly falling due from the Barcelona Electrical Company, £3,000 has been paid up to date, and on the payment of the last instalment next month, the Spanish patent will become the property of that Company. It has, however, been arranged that this company shall continue to supply them with Swan lamps on favourable terms.

"The litigation between this company and the Continental Edison Company in France and Belgium has not proceeded any further since the date of the last report. In Austria the pleadings on either side have been filed, but the case has not yet come on for hearing; more active proceedings have, however, been taken in Berlin, the company's agents there having been sued for infringement by the German Edison Company. Though no judicial decision has yet been given, the Berlin Patent Office, as official scientific advisers of the Court, have given their opinion that the Swan lamps are not an infringement of the Edison patents.

"An arrangement has been concluded by which the company has the option of obtaining the exclusive use on royalty of Mr. Tribe's patents for improved accumulators, if, after a prolonged trial, they should desire to do so, and careful experiments are now being made for the purpose of testing their durability and efficiency. Though the accounts submitted show a loss of £856 18s. 3d., it should be pointed out that there have been many expenses connected with the separation of the companies and with the removal of the factory from Paris that will not recur, and also that the business has suffered from the inability of the factories to meet their orders.

"When it is considered that the price of gas is generally higher abroad than in England, that it is, at the same time, not so generally established, that there are not the embarrassing parliamentary restrictions which fetter the growth of electrical enterprise at home, and that in some countries there is a constant and abundant supply of water-power, it will be seen that there is every reason to hope for a profitable result in the future.

"The accounts for the quarter ending 30th September, 1884, duly audited, are enclosed. They show a loss of £397 5s. 7d. on the quarter's trading, but this is more than accounted for by sums the company has had to pay to keep its trained hands and staff together at Lille, although in consequence of the fire there was little or no work for the hands and staff. The lamps sold during the quarter amounted to 28,264, against 16,529 in the correspond-

ing quarter of 1883. The orders received during the same periods were for 37,296 lamps in 1884, and 16,529 lamps in 1883. The Lille factory is expected to be in full work in three months, and the Cologne factory will, it is hoped, begin to deliver lamps in February next. As soon as these factories come into full work, the arrears of orders, now amounting to about 13,000 lamps, can be cleared off.

"The board have had under consideration the important question of the distribution to the shareholders of the shares allocated to this company in the amalgamated Edison and Swan Company, and which shares are now held 'en bloc' by the board as trustees for the shareholders. Pending the liquidation of the Edison Company and the settlement of the manner in which the interest of the Swan shareholders in the foreign business is to be dealt with as a separate asset from the shares in the amalgamated company, it has been found undesirable, if not impossible, to deal with the subject, but the board hope to be in a position to discuss it with the shareholders at the meeting.

"The following directors retire by rotation, but being eligible, offer themselves for re-election:—J. C. Stevenson, Esq., M.P.; Major-General J. S. Trevor, R.E.; Ernest Villiers, Esq."

The notice convening the meeting having been read,

The Chairman said he would trouble them with very few remarks. He was very sorry to see so small an attendance of shareholders; a great number of proxies had been sent to the board, representing about 35,000 shares, but he would much rather that the shareholders had come themselves. The report was made as full as possible, and a great deal of what he should have said was rendered unnecessary by the preliminary meeting of the Edison and Swan Company, when they had a very long story and a great deal of criticism, and they came to a certain conclusion. The board in whom, for the time, the shares of the Edison and Swan shareholders were vested, as trustees, announced their perfect readiness to retire if the proprietors thought fit, or to carry on the business. They did not think it seemly to take any resolution at that meeting, preferring to wait the issue of the present meeting and of that of the Edison company, which he supposed would follow. Of course there were a great number of wise people who could always prophesy after the fact, and, without knowing very much about it, and having very little sense of the facts of history, could put everybody right, and say that everything that had been done must be wrong. Well, they did not attach very much importance to that kind of criticism. They were quite satisfied, and they thought that they would have the concurrence of all the proprietors largely interested in the company that they had acted wisely—that it was a wise thing to fuse with the Edison Company. This, however, placed the Swan Company in rather a difficult position. As regarded the existing Edison and Swan Company, the shareholders had no legal vote at present, nor could they have until they got possession of the shares. Until then, they must rest satisfied that their business was in trust. With respect to the other asset of the Swan Company, that covered by the foreign patents, they would find that the balance sheet referred exclusively to the business conducted under that part of the affair. They would find in the balance sheet to June, 1884, that the share capital was represented by 19,750 shares of £5 each, fully paid, and 80,150 £5 shares each, £3 paid—in all £339,200. Under the fusion with the Edison Company they could only put in a portion of the business, the British patents, and in respect of that partnership the shares of the new company were divided in certain proportions, which division was a matter of agreement, and was not done without consideration or knowledge of both companies. They had got in the company, in respect of the British interest, so many paid-up shares, and so many shares with, at that time, £2 paid upon them, and instead of having one share in the Swan Company, they had a share representing a partnership in one undertaking and a separate asset in another, and as nearly as figures would bring it out, they had taken 61·46 per cent. with the United Company, and of course the balance of 38·54 in the separate asset. The proprietors in the Swan Company would be proprietors in the United Company to that extent. The only proper way to deal with the matter was to devise some means by which the present shares might be split, and the shares of the United Company distributed in respect of the 61·46 per cent., and a share in some other form be created representing the foreign business. That was what might be called the skeleton of the future proceedings. They had thought what was to be done with the foreign business. Was it to be carried on, or was there to be a fusion with the other company? There were some arguments in favour of this latter proposal, and some against. There were raised questions of gravity, and there was some difficulty with respect to the interests of the Edison proprietors in the United Company, and with respect to the deferred shares of Mr. Edison, the patents of the Swan Company having been bought out and out either in money or in shares—very unwisely as he thought—while Mr. Edison's patents were represented by deferred shares; they had a great deal of difficulty in bringing Mr. Edison to an arrangement in respect of the British interests, and they would have a great deal more difficulty in respect of the foreign patents, because he had sold his foreign interests, but as a man of honour, having been a party to the transfer of his own company here, he would scarcely in respect to a business abroad enter into severe conflict with people from whom he had already received consideration. The report and balance sheet before them, he would remind them, dealt with the state of the separate Swan Company only. The best that could be said of it, he thought, was that it was less bad than the report of the United Company, as showing that the loss on the working of the thing had been less considerable. But the

very same reasons which he adduced in explanation of the state of things he had to bring before the proprietors of the United Company held good, in fact more than held good, in this, for these separate interests were spread over a much wider surface, and required to be conducted with much more cautiousness, as there were many more difficulties, legally and otherwise. The story was on all fours with the one at home. They were there led to a fusion in order to escape litigation, and they were in litigation already abroad in half-a-dozen places, and until that litigation was terminated it would not be wise to put themselves to any large expenditure in forcing the patents. Still they were sufficiently advanced to make a start. The report told them exactly what had been done. It was true the result on the profit and loss account was not very satisfactory, and the question was whether a volume of business was likely to accrue sufficient to reverse that position. The directors thought it was, and in consequence had made up their minds to prosecute it. He believed he was speaking the opinion of his co-directors when he said that that foreign business offered quite as good a future as the English business, if not a better one. They had established factories at Lille and Cologne, but they were in litigation at two or three places—notably at Cologne. Of course they could never tell what would be the result, but they had drawn first blood, having obtained a technical decision in their favour. In the face of all this, notwithstanding the bad look of the balance sheet, and notwithstanding the very large sum of money paid for these patents, English and foreign, the directors' opinion was that the company would be wise to go on and not to throw up the sponge upon the result of the first year or two. He did not think the sum of money expended in electric lighting was so very appalling as to induce people to draw back without spending a little more. Of course it was very bad to throw good money after bad, but there was such a thing as throwing good money to get the other back, and that was what they should advise the shareholders to do. There was a great demand for the lamps they manufactured, and that was the principal part of the business. If they could maintain the patents of those lamps they could find a business in sufficient volume for a profit on all the money invested. He did not think they really need give up installation work or public lighting; he believed there was a great deal of useful installation work to be done on which a large profit could be made. But at present, at all events, it would be wise to limit themselves to the lamps as far as possible. That meant ready money for all they did, and he did not think they were likely to be easily tempted out of that path. In conclusion he moved that the report and accounts be received and adopted.

Major-General Trevor seconded.

Mr. John Balfour said it was not uncontrollable circumstances alone that had brought the company to its present position; it was mismanagement on the part of the directors, the chairman or the managing director, or the people whom they employed. Twelve months ago, with £2 10s. paid on their shares, they commanded a price of £1 a share; since then they had had to respond to a call of 10s. further, and at that moment the shares were selling at from 1s. 6d. to 2s. 6d. He was a stockbroker, and knew that what he stated was a fact. His opinion was that unless active steps were taken that day to alter the management, at the end of another twelve months they would have paid another call of 10s. per share, and that money would be sunk—gone goodness knew where—and their shares would still be worth 1s. 6d. or 2s. 6d.; and it was his firm conviction that they would again be met by Mr. Forbes, who would tell them that they had a very valuable invention and a very large business, but, unfortunately, all the capital was gone, and didn't they think they'd better wind up! At the foot of the report were the names of three gentlemen who sought re-election as directors; he had no personal knowledge of their names or qualifications, and he wanted to know what claims they had to his confidence. He took the trouble to go down to the office of the company, where he was shown the books. The minimum holding which qualified a director to look after their interests was 200 shares, and he found that Mr. Stevenson originally held 200 shares, and still held that number; General Trevor had 250 shares, but in 1882 thought he had 50 too many, so reduced his holding to the minimum of 200; Mr. Villiers originally had 250 shares, and had shown his confidence in the company by taking another 100; Mr. Swan, who had handed them over a business which, according to the chairman's showing, was not worth anything, originally held 1,500 shares, but he sold the lot in 1882. They would be told by-and-by that Mr. Swan had a very large interest in the company; he had a large number of fully-paid shares, as vendor's shares, for his valuable invention, and these he had never been able to sell. Mr. Crompton originally held 3,000 shares, but had sold all but 625. The chairman originally held 1,000, but in 1882 he sold 500. Mr. Balfour suggested that the capital of the company should be reduced to what had been lost, or that the shareholders should demand a pledge from the directors that no further call should be made without a meeting being held to tell the shareholders what it was to be spent on, and to obtain their sanction. He suggested further that they should have meetings, like every other company, twice a year; and that the retiring directors be not re-elected, but that a committee of twelve shareholders be formed to recommend three directors from amongst their number who held a large number of shares.

Mr. Kempster moved an amendment to the adoption of the report in the following terms:—"That in the opinion of this meeting it is not desirable to adopt the report and accounts now presented, but this meeting would urge the shareholders to

combine for the protection of their property; and for this end to seek the active co-operation of the large and influential shareholders, by whose aid it may be possible to control the management of this company and the amalgamated company; and this meeting is of opinion that no fees should be paid to directors except out of the profits of the said companies." He thought if this resolution were adopted by a show of hands it would have at least a moral effect, and would give the directors an opportunity of recording their proxies, so that the shareholders might be able at some future time to see who those gentlemen were who were banded together with the directors to keep control of the company, and to keep the general body of the shareholders at arm's length. There was a great reason why they should not accept the report and accounts; if they did it would be used against them for some legal purpose, to say that they had condoned, endorsed, and approved all that had gone before, and therefore he solemnly warned them not to pass the chairman's resolution. There were surely sufficient grounds for suspicion that all was not right; he had seen a remark in what he believed to be a very respectable financial paper, that the large sums of money paid for the patents had never found their way into the pockets of Mr. Swan and Mr. Edison. This was a very serious statement, and he mentioned it because he thought they ought to be thoroughly assured that it was absolutely false. If it did not go to them, into whose pockets did it go? If anybody occupied a fiduciary position in the promotion of the company they ought to have it back. At all events, the matter having been started in the public print, it was the duty of the board to attack that paper for libel and have the statement corrected; or else it was the duty of the board to give the shareholders the information which would enable them to recover their property. A year ago Mr. Forbes said, "If we strike a balance on the 30th of June and we find that our capital is intact, I think that will not be a bad outcrop." Did Mr. Forbes know twelve months ago the position of this concern? If not he was utterly incapable of occupying the position of chairman. Again, he said, "I think the thing has now arrived at the threshold of a great future, and we must carefully feel our way." Did Mr. Forbes believe that?

A Voice: No, no!

The Chairman: Who dares say "No"?

The Voice: A shareholder.

The Chairman: A shareholder! A shareholder has no right to traduce people, and I will not be traduced.

Mr. Kempster: I asked the question, not of a shareholder, but of the chairman. Do you believe it now, sir?

The Chairman: I do believe it now; of course I do!

Mr. Kempster: Then you must have been very ignorant of the state of affairs.

The Chairman: I say it now, and repeat it for your benefit. This man holds five shares only, and I do not know that he is not in league with people who are not trying for any benefit of yours (the shareholders), but for the benefit of somebody else, whose interest it is to damage the value of your shares.

Mr. Kempster: My word, to men who know me, is at least as good as the chairman's. I have not the slightest league with any interested party in this concern, except a few shareholders who have asked me to speak for them. It is true I only hold five shares; I wish my friends held no more. It is a simple aspersion from the chairman's lips, as offensive as anything that was ever uttered. Continuing, he said they had at the meeting to which he had alluded a distinct assurance that directors would not make any further call, unless it was for profitable employment. They had made another call, and it had not been a profitable one. What was wanted was co-operation amongst the shareholders, and he concluded by moving his amendment.

Mr. R. S. Swabey seconded the amendment.

Mr. Leyland, a director of the Edison and Swan United Company, said he had a large interest in this company also. Mr. Kempster had mentioned the names of several Members of Parliament whom he was very anxious to get on his combination of shareholders. One of these was Sir John Lubbock. Sir John Lubbock addressed the aggregate meeting of the United Company recently, and took the very strongest part against the views Mr. Kempster then expressed. And they had no reason to suppose that he had changed his opinions completely in so short a space of time. He would remind the shareholders that it was a very unwise thing to change horses in crossing a stream, and they had a very deep and dangerous stream to cross. From what he saw at the amalgamated board, he believed it would be an act of pure insanity on the part of the shareholders of this company to introduce so discordant an element as a committee of investigation. Mr. Balfour had suggested a reduction of capital; but that would take months, and might take years, to carry out, and they would have to obtain the consent of every creditor of the company. What he thought was desirable was that the shares should be divided and placed in the hands of the shareholders at once. They could determine now to take the proper steps for the distribution of the shares; they must give notice of the liquidation of the Swan Company; they could then divide the capital and allot the shares in the amalgamated company to the parties entitled to them. He put that before them as a thing that could be done without any difficulty.

Mr. Quilter said he was very glad that Mr. Kempster had been bold enough to substantiate, or attempt to substantiate, those very vague hints which had been thrown out by the articles of "that respectable, independent financial paper." He was glad, because it enabled him, conversant as he was with every fact relating to the formation of the company, to give a few statements which would

once and for all, he thought, set at rest any suspicion in the minds of the shareholders that there had been anything in the formation of the company which any investigation committee, however hostile, would not consider to be straightforward and satisfactory. On reference to the books of the company, he found that the preliminary expenses amounted to £624 12s. 10d. This sum included commission to brokers whose clients took shares. None of it was paid to him (Mr. Quilter). The only payment he received was a fee from Messrs. Swan at the time he undertook the formation of the company. He took shares amounting to five times as much as his fee, and those shares, with a few more, he still held. He shared the Chairman's opinion as to the future of the company, and he was able to say that he still believed that, with good management the future of the Swan Company was as bright as when he was induced by Mr. Crompton originally to look into it. He had lost three times the amount of the fee he received, and he stood now to lose five times. Nearly one-half of the shares was taken by his own friends and a very large majority was now held by them. He gave them his word that he found this in the books of the company—that Mr. Crompton received every penny to which he was entitled, as also did Mr. Swan. Not having anything to do with the Edison Company he could say nothing as to the payment for the Edison patents. He therefore had great pleasure in saying that there was not one particle of truth in the statements raised. Those Members of Parliament and others whom Mr. Kempster had, somewhat injudiciously as he thought, brought into prominent notice, were almost all friends and clients of his (Mr. Quilter's), and would unite with him in supporting any proposition for the real interests of the company, and had no personal ends to serve.

Mr. Leyland said: That as a director of the Edison Company he knew that the statements that the money had not gone to Mr. Edison was perfectly untrue.

Mr. Stevenson, M.P., one of the retiring directors, having stated that although he only held 200 shares himself, his family held a large number, and other gentlemen having spoken,

The Chairman put the amendment to the meeting, and declared it lost, and subsequently the original motion was carried.

Mr. Kempster demanded a poll, but eventually withdrew his request.

The Chairman stated that the next business was the election of the directors in the place of the three who retired. After some discussion, it was agreed to adjourn the meeting for a week for the purpose of electing three directors.

The Chairman then submitted a motion "That the directors be requested to take the necessary steps for distributing amongst the shareholders, the shares of the Edison and Swan Electric Light Company, Limited, now held by this company."

Major General Trevor seconded, and the motion was carried unanimously.

Messrs. Quilter, Ball & Co., were re-elected auditors of the company, after which, a vote of thanks to the Chairman having been accorded, the meeting adjourned.

Brush Midland Electric Light and Power Company, Limited.

At the Cannon Street Hotel on Tuesday afternoon, the ordinary general meeting (followed by an extraordinary meeting), of this company was held under the presidency of Mr. R. H. Glyn. The attendance was very limited.

In opening the proceedings,

The Chairman said: As you are aware, gentlemen, there are two meetings to-day: one is merely a formal meeting and is only to pass the accounts; the other and more important meeting is to consider our amalgamation with the Anglo-American Brush Corporation which has been proposed to you. I have very little to say about the accounts except to point out, as you will have found for yourselves, that on the working year, there has been a loss of about £1,000. We have kept the expenses as low as we could, and I think the only thing we can say is that under the circumstances we are very thankful that loss is not more. Unless you wish to ask any questions, perhaps you will formally pass them, and I will then propose the special resolutions to which I shall have to refer more particularly. The Chairman accordingly moved the adoption of the report and accounts to 31st October last, as follows:—

"The directors beg to report that the profits of the business for the past year have failed to meet the working expenses, and accounts showing this result will be submitted to the shareholders.

"In view of the difficulties which surround electric lighting at the present time, and especially considering that there appears little chance of successfully carrying on the company's business with so small an available capital, the directors have anxiously considered what course was best to be pursued in the interests of the shareholders.

"With this view they have made a provisional agreement for a fusion with the Anglo-American Brush Corporation, Limited, on the basis of that company issuing to the members of this company their shares in the proportion of one £5 fully-paid share in that corporation for 6½ shares of £2 10s. paid in your company, the former company taking over the assets and liabilities of this company as a going concern.

"The board strongly recommend the adoption of this plan by which your holding will have an immediate market value, and if,

as is reasonable to suppose, the large capital of the Anglo-American Brush Corporation enables them to deal successfully with the problem of electric lighting, shares in that company will have a good prospective value."

BALANCE SHEET, made up to 31st October, 1884.

DR.		£	s.	d.	£	s.	d.
Share capital—							
3,200 vendors' shares of £5 each,							
fully paid		16,000	0	0			
21,800 shares of £2 10s. each ...	54,500						
25,000							
Less arrears of calls, £4,101							
2,758 „ shares cancelled							
and forfeited 6,895							
		10,996					
22,242		43,504	0	0			
					59,504	0	0
Amount paid on 170 forfeited shares ...					255	0	0
Debts and liabilities of the company—							
Sundry trade creditors		189	7	10			
Directors' fees		500	0	0			
Law costs		207	8	9			
					896	16	7
					£60,655	16	7

Note.—Interest on calls in arrear estimated at £880.

CR.		£	s.	d.	£	s.	d.
Property—							
Purchase of concessions					43,750	0	0
Cost of installations on hire		2,308	15	11			
Stock at current cost prices		917	19	3			
Plant and tools		599	12	6			
					3,826	7	8
Furniture and fittings at cost					161	13	5
Sundry debtors					832	2	8
Cash in bank					5,499	16	3
Preliminary expenses as per last balance sheet ...					200	0	0
Revenue account—							
Balance per accounts to 31st Oct., 1883	5,298	3	9				
Loss year ended 31st Oct., 1884 ...	1,087	12	10				
					6,385	16	7
					£60,655	16	7

Mr. Russell Evans (one of the directors) seconded the motion.

Mr. Stokes (a shareholder) said: The shareholders will want a little more information. It is 12 months since we agreed to try the concern longer, and we have met with no result. I think the directors' fees and salaries are very high.

The Chairman: The directors were entitled to £1,000 per annum by the articles, but they have taken only half their fees. Salaries have been kept as low as possible.

The resolution was then put and carried.

EXTRAORDINARY MEETING.

The Secretary next read a notice convening the extraordinary meeting.

The Chairman: I think, gentlemen, this is now the special meeting to consider the resolution which proposes to approve of the agreement we have made with the Anglo-American Brush Corporation, and Mr. Davies, our solicitor, will explain the effect of it.

Mr. Davies: The agreement is dated the 29th November last, and is made between the Brush Midland Electric Light Company of the one part, and the Anglo-American Brush Electric Light Corporation, Limited, of the other part. The first part provides that the Midland Company shall sell and the Anglo Company shall purchase practically all the assets of the Midland Company; and as part of the consideration for the sale, the Anglo Corporation shall satisfy all the obligations of the Midland Company, and that as a further consideration, each member of the Midland Company shall be entitled to acquire, at any time during the next six months, four fully paid up £5 shares in the Anglo Corporation for every twenty-seven £2 10s. shares in the Midland Company, and so in proportion for any greater or less number held by him. But every requisition for these shares must be in writing, and must be signed by the party requiring them, as well as countersigned by the liquidator of the Midland Company. And in the event of a person not holding enough shares in the Midland to entitle him to the fully paid up shares of the Anglo Company, fractional certificates shall be issued for buying and selling, so that by purchasing others he may be entitled to receive the fully paid up shares of the Anglo Company. And then there is a provision that the Anglo Company is bound in due course to pay off a number of these shareholders. The transfer or sale is to take place before the 23rd of this month. That is the substance of the document. As a consequence of this agreement, if it is approved, for the purpose of giving it legal effect, this company will have to go into voluntary liquidation. That will be the second resolution of to-day's meeting.

The Chairman: Gentlemen, you have heard our solicitor's explanation of the legal position, and you will want to know from me what has induced us to adopt this plan. The last time we met,

we told you that we hoped that the amount we had spent in advertising the company very thoroughly, might lead us to some returns hereafter—in the past year, in fact. But we have been unfortunate enough not to be able to realise that. The fact of the matter is this. We have a very small capital, and we are obliged to work in this way: to try and get as many orders from people as we could to put up installations on their own premises. That would pay us, as our capital would not amount to enough to put up central stations, which work requires a good deal of money, and means waiting a long time to get any result. Any quantity of people would take the light if we could give it them as the gas companies do. But we found people would not—and I don't wonder at it, considering the state of trade for the last year or so—put up installations on their own account. We have done this for some, but they have been but small, and we have not been able to pay the small expenses which we have incurred in the year. Then it became necessary to consider what should be done. As to raising fresh money for electric lighting at the present moment, it is perfectly clear that is impossible. It became, therefore, a question really whether we should liquidate ourselves or endeavour to sell ourselves to some other company. I put myself in communication with Lord Thurlow, the chairman of the Anglo-American Brush Corporation, and we went into figures carefully. The result is this: if we accept this proposal, which is to give us one of their £5 fully paid shares for six-and-three-quarters of our £2 10s. shares, we shall get in cash a little more, and otherwise considerably more, than we could possibly get if we liquidate to-day. We shall, in that case too, save all the liquidation expenses, which would be considerable. And I see there is one item here of installations as a going concern, and in liquidation they would, although worth money, fetch very little. This arrangement proposed is one so advantageous that we ought not to hesitate at all in accepting it. You all know that liquidation is very unpleasant. In the present case it will be voluntary, and the expenses will be paid by the Anglo-American Brush Corporation, and we shall get more than we should if we did it ourselves. I do not know that I have anything further to say to you about the matter. That is exactly the position of things, and it seems to me—and the board has gone into the matter very carefully—that this proposal is by far the best course to adopt under the circumstances.

The Chairman moved the resolution: "That the conditional agreement submitted to this meeting, and made between this company on the one part and the Anglo-American Brush Corporation on the other part be, and the same is hereby approved and sanctioned."

The resolution having been seconded by Mr. Pender, one of the directors,

A Shareholder (whose name did not transpire) said: Before that is put, Mr. Chairman, may I say that I think if we liquidate now, we shall be sure of getting something, whereas by amalgamating we are entering into an uncertainty, and shall, perhaps, get nothing; and if the prospects of the parent company are not greater than what I understand them to be, I think we shall lose all.

The Chairman: Pardon me; I think you have put it rather the other way about. If we liquidate we shall get less than by accepting the present proposition.

The Shareholder: If we accept shares in another company whose shares are going down, and likely to go down while the present Act of Parliament is in existence, we shall perhaps get less. Is it not better to accept a certain amount, than to pay 7s. 6d. towards an uncertainty, as the Anglo-Brush is. Certainly, if they were proceeded against and liquidated, we should lose all. Don't you think it would be more advisable to accept the smaller amount now than to risk what we have. The prospects of the Brush Corporation are not very great. You will remember what these shares were two years ago. They have come down, and down, and down, and I fear will go on coming down to nothing. The reason is, their prospects are not great; and they cannot possibly succeed if they have not the apparatus. They have only part of the necessary machinery. The incandescent lights are not theirs; they are not their patents. They simply hire them from others, and the fabulous price paid by this and other companies certainly has brought men to look at the matter in a different light to that in which they looked at it some time ago. In fact, instead of paying we ought to be paid for amalgamating.

Mr. Matthew (another shareholder): After our experience of the Anglo-Brush Corporation, and considering the fact that they sold us for £43,000 a patent they did not possess, I do not think we have any right to put our assets into their hands. They are absolutely unreliable, and we cannot trust them. The £5,000 cash we have is equal perhaps to a 10 per cent. return, and I will move that we have a voluntary liquidation, and that four or five shareholders be appointed as a committee of inspection.

Mr. Durridge: I will second that.

The Chairman: As a matter of fact we shall get shares from the Anglo-American Brush Corporation which will be equal to cash.

Mr. Harrington (a shareholder): I say I have bought Anglo-American shares, and they have gone up ten shillings during the past month, so that it's nonsense to say they have no value.

Mr. Hewett: I think I am one of the largest shareholders in this company. I feel confident the directors have done their best. It is far better to accept shares in the parent company, than to take two or three shillings per share at present.

A Shareholder rose to speak, and was intercepted by

The Chairman, who said: I may say we have an overwhelming number of proxies, so that you are wasting the time of the meeting.

A Shareholder: Allow the gentlemen present, Sir, to have a

voice. We came here last year to listen to your remarks, and from the statement you then made, I with other other gentlemen here, thought that our company would advance much more than it has done. Instead of advancing, it has gone back and lost estimation with the public. I think there has been a great deal of deception about it (Hear, hear).

Mr. Chinery: If the company be wound up voluntarily, what amount per share would be returned? The cash in the bank is £5,500, and sundry debtors £832. That seems almost to amount to as much as we should get by accepting shares?

The Chairman: No: I think if we were to wind up and take into account the expenses of liquidation, and what the installations which are here mentioned would fetch—if we take into account all that, we should get 8s. 10d. per share; but you might make it 6s. really.

Mr. Chinery: The cash seems very large.

The Chairman: We should have to divide in with the Anglo Brush Corporation who hold about a fourth of our capital.

Mr. Matthews: For £17 they give us about 30s. That is their policy all through.

A Shareholder: Are the installations a paying concern?

The Chairman: Yes, moderately well.

A Shareholder: Moderately well? That is very ambiguous.

The Chairman: Well, they about pay their expenses.

A Shareholder: Then, I say, you directors ought to be ashamed of yourselves.

Mr. Davies: I understand that Mr. Matthews moves, and Mr. Burridge seconds, that instead of the resolution which the Chairman has put to the meeting, this shall be as an amendment:—"That the company be wound up voluntarily, and a committee of five shareholders be appointed to liquidate it." The Chairman must put the amendment first.

The Chairman then put the amendment and the resolution respectively, declaring the latter carried, and afterwards mentioning, in reply to an enquiry, that the proxies which the directors held represented more than a half of the whole voting power of the company.

Mr. Davies: The next resolution is "That with a view to carrying into effect the agreement submitted and approved by the extraordinary general meeting of this company held this day, the company be wound up voluntarily under the provisions of the Companies Act."

This resolution was proposed by the Chairman, seconded by Mr. Pender, and declared to be carried; the Chairman then announcing the proceedings at an end.

Great Western Electric Light and Power Company, Limited.

An extraordinary general meeting of this company was held at the Cannon Street Hotel, on Monday last, Mr. J. B. Braithwaite, jun., presiding. A circular issued by the directors, which appeared in our last issue, stated that an offer had been made by the Anglo-American Brush Electric Light Corporation to take over the Great Western Company as a going concern.

Mr. Allender, the secretary, having read the notice convening the meeting;

Mr. Crisp, the solicitor, being requested by the chairman to do so, stated the terms of the conditional agreement which had been drawn up between the two companies. Article 5 stated as follows:—"As further consideration, the liquidators shall, within fourteen days after the passing of the special resolution for winding up the Western Company, pay to the directors of the Western Company, out of the cash belonging to the Western Company, a sum of money equal to 10s. in respect of each share upon the written personal undertaking of the directors to apply such sums of money in payment of a dividend of 10s. per share to the shareholders in the Western Company on each share held by them; and in addition to such payment as aforesaid, each member of the Western Company shall be entitled to require the Brush Company at any time within three calendar months from the date hereof, to allot to him three fully paid-up £5 shares in the Brush Company in respect of every 20 fully paid shares in the Western Company held by him."

The Chairman said when they last met, about two or three months ago, the directors little thought they would so soon have to meet the shareholders again; they had no idea at that time that anything of this sort would be proposed to them. About a month or six weeks ago, the Brush Company made overtures to them, enquiring on what terms they were disposed to make over the company. The result of the negotiations which followed was the offer they had laid before them. They had endeavoured to draw up their circular so as not to bring any pressure to bear upon the shareholders, but merely to ask them to decide by their common-sense and business judgment whether they would accept the offer or not. Since that circular was sent out the directors had received proxies to vote against the proposals to the number of 3,334, and proxies in favour of the offer numbering 14,509; they had also received the concurrence of the liquidator of the Devon and Cornwall Company, for the 3,000 shares which he held. He wished to correct one or two impressions which were evidently in the minds of some of the shareholders. Some of them appeared to think that the fully paid shares of the Brush Company were £10 shares, but this was a mistake—they were only £5, the capital having been reduced since the formation of the company to one-half. The exact terms of the proposed transfer were these:—This company had 27,816 shares altogether, including those to be

allotted to the Devon and Cornwall Company, and the directors reserved to themselves the right to distribute amongst the shareholders the balance in hand, about £14,000 in cash, 10s. for every share held; and then each shareholder would receive 15s. for every share held in fully paid Brush shares at the market value. The present value being 3½, they would receive 10s. 6d. for their 15s., representing £1 0s. 6d. per share. The balance sheet showed them that, if they went into liquidation, the return would not be so good as that, and he thought the shareholders would be acting wisely in accepting the offer. The directors naturally felt anxious, when these negotiations were opened, as to the position of the Brush Company. In endeavouring to rescue this company from the wreck it appeared about to be involved in, they felt they ought not to make it over on any terms, unless they were fully satisfied that the position of the Brush Company was at least as good as its own. Accordingly, Mr. Reynolds and himself held an interview with Lord Thurlow, chairman of the Brush Company, in which the whole position of the latter company was unhesitatingly and unreservedly discussed, and all their questions were answered in the fullest and frankest manner. On the strength of what they ascertained, he thought the shareholders had acted wisely in giving the board the large majority which they had done in favour of the proposals. It should be borne in mind that whilst the capital of the Brush Company had been reduced one-half, that of the Great Western Company remained the same as when it originally started, and therefore every £5 share they received would be equal to £10 when the company was started, and instead of 15s. in fully-paid Brush shares, they got 30s., and 10s. in cash, thus representing £2 out of the original £2 10s. He then moved the following resolutions:—

1.—“That the conditional agreement submitted to this meeting, and made between this company of the one part, and the Anglo-American Brush Electric Light Corporation, Limited, of the other part, be, and the same is hereby approved and sanctioned.”

2.—“That with a view to carrying the said conditional agreement into effect, the Company be wound up voluntarily, and that Mr. Emile Gareke and Mr. F. W. Reynolds be, and they are hereby appointed liquidators for the purpose of such winding up.”

3.—“That pursuant to the Companies' Act, 1862, the said liquidators be, and they are hereby authorised and directed to adopt, on behalf of this company, the said agreement, and to receive paid-up shares in the said corporation, as consideration for the property thereby agreed to be sold in accordance with the terms of such agreement, and generally to carry the same into effect.”

Mr. Stewart seconded these resolutions.

Mr. A. Backhouse moved that the offer which had been made by the Anglo-American Brush Corporation be rejected. He happened to be in Manchester a few days before, and while there made some enquiries about the electric light—generally as to the progress it was making, and also about the Brush Company in particular. He was fortunate enough to meet with a gentleman who had had a great deal to do with electric light, and learnt from him that it was spreading considerably, and he also stated that the Victoria lamp manufactured by the Brush Company is acknowledged to be one of the best in the market. In their circular, the directors said the offer was made to them unexpectedly, and, without fairly considering it as one acceptable to the shareholders, they merely submitted it to their approval. He gathered, however, from the remarks made at this meeting by the chairman, that he thought the shareholders would be right in accepting it. The last balance sheet presented showed that they had over £16,000 in cash—he thought perhaps the chairman in his address would have stated what the amount of cash in the bank was at that time; but taking it roughly there was something like £16,000 in cash—then there was land and other assets worth about £13,700, so that altogether the company appeared to possess about £30,000 in cash and property, which the Brush company would get. For this £30,000 they were offered £12,700 in cash, and of that over £1,800 went to the Brush company itself, so that all the cash would be £11,000 only.

The Chairman stated that the total amount of cash to be paid was £13,908, not £12,700.

Mr. Backhouse: Very well; it is reduced, then, to £12,000. That will be all we shall get for £16,000. Continuing, he said in the same way they would receive the full value for the property they possessed. But for the patent rights which the company purchased only two years ago, they were going to receive nothing whatever. There were no Brush shares to be given to represent those rights, for which over £27,000 were paid to the Brush company, besides £15,000 in shares. He learnt that the Brush company had been making efforts to buy up another of the subsidiary companies, and he did not know that they were not offering to buy up all. Seeing that the Victoria lamp was admittedly one of the best, and that the prospects of electric lighting were better than ever before, it did seem a little strange that the Brush company should ask subsidiary companies to surrender the whole of their rights, for which they paid three-fourths of the capital, for not one single half-penny. In whichever light this offer was looked at, it was a most extraordinary one. In the last report the directors issued, they stated that the Brush company had given £2,300 of their own shares for the right to light trains; that was to say they considered at that time—in the spring of the present year—that for this company to sacrifice only a part of its rights it was entitled to shares which were worth £2,300 in the market. Then again, when the Devon and Cornwall company was wound up, 3,000 shares were given to the liquidator to represent the money paid to this company. How was it they were now to be dealt with in a different manner?

It seemed to him such an act of spoliation and almost robbery that he had come 200 miles purposely to oppose it. If Brush shares were given to the shareholders of this company to represent £27,000 in cash, that would, at any rate, be some acknowledgement of the rights which they were now asked to give up for nothing. Then also, the shares which the Brush company held were to share in the division; it was monstrous that those shares were not to be surrendered. He held strong views on the subject, and he hoped no shareholder would consent to the sacrifice that was asked of him.

Mr. Waters pointed out that they were receiving much greater consideration than appeared on the surface. They obtained greater value than they would have done if this offer had been made and accepted at an earlier period, the Brush company having wiped off the cost of their shares.

The Chairman thought Mr. Backhouse's remarks rested principally upon a misconception of the terms. He seemed to have lost sight of two or three very important facts. Each Brush £5 share they were now getting represented £10 of the original capital of the company. If they went back to the time they bought their rights they got 30s. instead of 15s. The amount of credit of the company was about the same as appeared in the last balance sheet—between £16,000 and £17,000 altogether. The bulk of that would be distributed to the shareholders. The remainder they thought it was only right to make over to the Brush Company, for the two lighting stations it was taking over—one at Bristol and the other at Cardiff—would require some capital to carry on. With regard to the case of the Devon and Cornwall Company, that was hardly on all fours with this; that company had a claim against the Great Western Company amounting to £29,000, which, if it had been given against the latter, would have rendered the company entirely bankrupt. Under the circumstances the directors thought they had made an arrangement that was fair and equitable to both sides. This case was of a different character. They were not bringing an action against the Brush Company; that company came to them and asked them upon what terms they would go into partnership.

A Shareholder asked what arrangements had been made with respect to payment to the liquidators.

The Chairman said no arrangement had been made, as it did not fall upon this company in the slightest degree. The Brush Company undertook to pay all the expenses of liquidation.

Mr. Reynolds, one of the proposed liquidators, intimated his intention to receive no remuneration whatever.

The resolutions were then put, and carried with but three dissentients.

In reply to a Shareholder the Chairman stated that holders of ten Great Western shares would receive £5 in cash and 1½ shares in the Brush Company—one full share and a fractional certificate for £2 10s.

A vote of thanks to the chairman then terminated the meeting.

Oriental Telephone Company, Limited.

THE directors have issued a circular in reply to that of Mr. Thomas Lloyd, in which they state that the only point raised in that circular which has not been already anticipated by the board in their circular of the 29th ult., refers to the relations of the fully paid up shares to the part paid up shares. In order that proprietors may not be deceived on this point, they are reminded that the holders of fully paid up shares cannot benefit in any way until the part paid shares have received cumulative dividends to the aggregate amount of 30 per cent. Hence it must obviously follow that the holders of fully paid up shares are even more interested than are the holders of part paid shares that the capital called up on the latter shall be kept down to the lowest possible figure, and adds:—“The directors cannot pass over the unworthy suggestion of an intention on their part of allowing the company to drift into a liquidation, so as to benefit the holders of fully paid-up shares. It ought not to be necessary to say that there is nothing in the position to justify such a suggestion. Shareholders must, however, themselves judge whether the present agitation is the best mode of avoiding the liquidation which Mr. Lloyd appears so much to fear.”

Kelway's Electric Log Syndicate, Limited.—Mr.

Justice Kay has fixed the 22nd inst. for the appointment of an official liquidator.

The Eastern Extension, Australasia and China Telegraph Company, Limited.—The directors have declared an

interim dividend for the quarter ended September 30th last of 2s. 6d. per share, free of income-tax, payable on January 15th. The coupons on the Companies' 5 per cent. Australian Government Subsidy Debentures, due January 1st, will be paid by Messrs. Barclay, Bevan & Co., 54, Lombard Street.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 5th, were £2,225; after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited. The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending November 30th were £4,150.

NEW PATENTS—1884.

15547. "Telephone switches." T. BALLARD. Dated November 26.
15555. "Portable and disjunctive telephones for railway trains." W. H. BLACKWELL, H. H. and A. TURNER. Dated November 26.
15566. "Regulating apparatus for electric arc lamps." G. E. VAUGHAN. (Communicated by Austrian Small Arms Manufacturing Company.) Dated November 26.
15567. "Primary battery." A. E. UPWARD, C. W. PRIDHAM. Dated November 26.
15574. "Generating electricity by motive power for the purpose of lighting railway trains, carriages, and all other vehicles." W. A. DUNCAN. Dated November 26.
15579. "Art of telephony." C. A. DAY. (Communicated by J. Lowth and W. D. Ewart.) Dated November 26.
15580. "Art of telephony." C. A. DAY. (Communicated by J. Lowth and W. D. Ewart.) Dated November 26.
15581. "Telephones." C. A. DAY. (Communicated by J. Lowth and W. D. Ewart.) Dated November 26.
15582. "Telephones." C. A. DAY. (Communicated by J. Lowth and W. D. Ewart.) Dated November 26.
15583. "Telephones." C. A. DAY. (Communicated by J. Lowth and W. D. Ewart.) Dated November 26.
15592. "Electric telephonic apparatus." A. A. CAMPBELL-SWINTON. Dated November 26.
15597. "Contact and reversing gear for electro-dynamic machines." E. J. HOUGHTON, T. M. COLLET. Dated November 26.
15612. "Fittings for carrying 'safety fuses' for use in electric circuits." G. C. SILLAR. Dated November 27.
15637. "Holders for incandescent electric lamps." H. H. LEIGH. (Communicated by J. D. Petersen.) Dated November 27.
15648. "Dynamo-electric machines." W. MATHER, J. and E. HOPKINSON. Dated November 27.
15664. "Electric lighting, viz., an arc lamp in which the carbons remain unchanged." C. SIBLEY, A. SWINFORD. Dated November 28.
15666. "Non-vacuum electric glow lamps." E. FAHRIG. Dated November 28.
15667. "Carbon for incandescence lamps." E. FAHRIG. Dated November 28.
15692. "Construction of thermo-electric piles." J. LEA, G. C. HARVEY. Dated November 28.
15711. "Electro-telephonic apparatus." A. A. CAMPBELL-SWINTON. Dated November 28.
15713. "Primary voltaic batteries." D. G. FITZGERALD, T. J. JONES. Dated November 28.
15754. "Incandescent electric lamps." G. DAVIDSON, R. C. JACKSON, J. B. DUNCAN. Dated November 29.
15760. "Armatures of dynamo-electric machines, and in the means of collecting the current from the commutator thereof." T. PARKEE. Dated November 29.
15764. "Means employed in the production of the vacuum in the bulbs of incandescent electric lamps." G. DAVIDSON, R. C. JACKSON, J. B. DUNCAN. Dated November 29.
15768. "Electro-dynamic motors." T. J. HANDFORD. (Communicated by F. J. Sprague.) Dated November 29.
15772. "Voltaic batteries." D. G. FITZGERALD, T. J. JONES. Dated November 29. (Complete.)
15797. "Regulating electric currents." W. H. SCOTT, E. A. PARIS. Dated December 1. (Complete.)
15831. "Apparatus for electric lighting." R. H. C. NEVILLE. Dated December 2.
15864. "Electric arc lamps." G. W. BUDD. Dated December 2.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

10. "Improvements in electric lamps emitting light in a vacuum." W. E. DEBENHAM. Dated January 1. 2d. In order to get rid of occluded gases from the metallic and carbon conductors in electric lamps, and to make the vacuum and sealing of the joint where the conductors enter the globe more perfect, the inventor completes the exhaustion of the globe whilst the whole is raised to as great heat as the glass will bear without deformation; and in order that this heat may be as high as possible, he employs a glass of a kind which only melts at a very high temperature. By additionally raising the heat at the place of insertion of the conducting wires whilst the globe is exhausted he obtains closer union of the glass and metal.

280. "Improvements in galvanic batteries and arrangements in connection with them." J. ENRIGHT. Dated January 2. 6d. A cistern is filled with the mixture of bichromate of potassium and sulphuric acid. It may be filled by a pipe from a central station (from which many batteries may be fed) or otherwise. From this cistern pipes carry the bichromate mixture to the different cells. These pipes debouch into the cells at the most suitable points for producing a disturbance of the fluids in them, and they are governed by floats in the cells so that an overflow of the latter cannot occur. From the cells pipes proceed and carry away the fluids at a regulated rate. The points from which the exit pipes originate are also selected with a view towards furthering the disturbance aforesaid. The used bichromate mixture drops into a waste tank from which it may flow back to the central station, where it may be transformed by chemical processes into bichromate of potassium or other useful material. A similar arrangement is made for a second fluid if two fluid cells be used.

411. "An improved holder for electric lamps." R. BARLOW. Dated January 2. 2d. The inventor constructs the holder in two sections. The undermost section consists of a tube screwed at its lower end for attachment to the bracket or other fitting carrying the light, and screwed or fitted at its other end for receiving the upper section of the holder. A plug of insulating material is placed loosely in the upper portion of the tube, and is pierced with two holes for the ends of the current wires to pass through. The upper section of the holder consists of a short tube suitably screwed or fitted to connect with the lower section, and contains a plug of insulating material carrying springs, or other hooks or attachments, for holding the projecting loops of the lamp. These hooks or attachments terminate by stems passing through the plug to its lower end, where they form contact-plates and make contact with the current wires when the upper section of the holder is placed in position on the lower section.

CORRESPONDENCE.

Electric Lighting in America.

The report of the meeting of the Society of Arts upon this subject must have aroused a feeling of shame and indignation in the minds of all your readers who are interested in the electric light; shame, that as a nation we should be so far behind America in what is now admitted, on all hands, to be the most conspicuous improvement and advantage which modern ingenuity has devised; and indignation that this result should have been brought about by the passing of an ill-digested Act of Parliament in a period of panic.

The public is now weary of the oft-repeated tale which has been told, *usque ad nauseam*, that "the whole thing was premature;" that "an attempt was being made to create another monopoly;" that "promoters had made large sums of money;" that "the object in view was the sale of worthless patents rather than the establishment of a valuable industry," &c., &c., &c. Be it so; but this fact remains, and cannot be gainsaid, that until the Electric Lighting Act be repealed, or materially altered, no rational men will now embark their money, nor will any honest and prudent board of directors lay out the money of their shareholders in electric lighting enterprise in this country.

In the neighbourhood where I live (Marylebone) the streets are simply unsafe after dusk, except on moon-light evenings, on account of the feeble light from the gas lamps. At other times, a torch or bull's-eye lantern is almost a necessity in crossing the streets.

I am only one of tens of thousands in London who would gladly pay anything within reason to have the electric light inside as well as outside their houses. Gas is so injurious to health, and so detrimental to furniture, ceilings, pictures, &c., that I have resorted to the use of oil lamps and candles almost throughout my house.

Before Mr. Chamberlain's Act was passed, I made two or three efforts to get the electric light introduced into the neighbourhood where I reside, and should probably have succeeded; but before I could bring these efforts to a successful issue the Act was passed, and the company with whom I was in treaty, and I myself, saw that they were hopeless, and abandoned them.

Is the foolish fear of a monopoly to stand any longer in the way of the successful prosecution of a discovery which is so beneficial to health, so preservative of property, and last, but not least, so conducive to public

safety, that the Chief of Police in New York has gone so far as to say that "every electric light erected means a policeman removed?"

R. B.

December 10th, 1884.

Electric Signals.

The correspondence that has recently arisen respecting the great annoyance caused by the use of the railway whistle, and also the detonating fog signals, emboldens me to write you that we have offered a system which renders their use unnecessary to the authorities of the District Line, who declined to try it, on the ground that their signal-boxes and stations were so near together, the train was hardly ever out of sight of one or other of them, and therefore they did not require any other signals than those in use; by the Tilbury Line, on the ground that they were then too busy to give it a trial; by the Great Western our first application was declined, but on referring it to them again, and attending personally at Paddington, we were told we should have a trial, but that the consent of the directors must first be obtained.

The invention was in January of the present year tried for the first time on the Belfast Central, in the presence of Mr. Bucknall Cooper, the engineer of the line, who writes:—"I have to-day had the pleasure of witnessing your experiments on electric signalling. I am satisfied that a system of signals could have been kept up between the train and the signalmen in the station by electricity, during the time the train was in motion."

In August of the present year it was tried on the Tenby Line, in the presence of Dr. Hopkinson, F.R.S., who was sent down by the directors of the Electric Signal Company to report to them on the invention. He writes:—"I carefully verified the working of every part of the apparatus, both from the point of view of the signalman at the station, and from the point of view of the driver on the locomotive. In my presence every part of the apparatus performed perfectly, the signals on the locomotive were unmistakable, and the contacts were properly recorded upon the drum at all speeds of the locomotive up to fifty miles per hour, the maximum it was practical to obtain." This drum records the progress of the train automatically, thus keeping a permanent record of each train's journey, and informs the signalman of its position on the line.

I am authorised to state that our electrician, Mr. Enright, B.Sc., Lond., will attend here by appointment to demonstrate to any railway engineer, electrician, or director, who wishes to inform himself of the truth of what I state, viz., that at a very trifling expense we actuate a semaphore, and ring a bell electrically on the engine, or guard's van, or both, and enable the driver to communicate with the signalman, either in front or rear of him in such a way as to entirely obviate the use, either of steam, whistle, or explosive fog signals, and that the system can be used either in conjunction with, or without, the present system of visual signals.

Charles Pridham,

Vice-Chairman "Electric Signal Company, Limited."

62, Hogarth Road, S.W.

The Gulcher Electric Light and Power Company, Limited.

Your report in yesterday's ELECTRICAL REVIEW of the meeting of the Gulcher Electric Light and Power Company, Limited (the accuracy of which I do not question), states that "misrepresentation" has been applied to me with regard to transactions I have had with the company.

As the case is *sub judice*, I cannot ask you to allow me through your columns to vindicate myself, but as my silence under such an accusation may be open to misconstruction, I would ask you to permit me to say that I am advised that I have a most complete answer to the case which the company sets up against me, and that the chairman of the company, in his speech to the shareholders, forgot or omitted to mention (probably owing to his recent connection with the company) the

sacrifices I have, from time to time, made in their interests, and the confirmation over and over again by the company of my past dealings with them, of which dealings they now, for the first time, complain.

William Crookes.

London, December 6th, 1884.

Trouve's Bichromate Batteries.

I shall esteem it a favour if you will kindly inform me, through the medium of your next issue, the constituent parts used in the solution for Trouvé's bichromate batteries. I have tried several times, but the results have not been gratifying, owing I presume to some error I have made in the use of the chemicals.

H. S.

[Full particulars of the formation of this battery, together with M. Hospitalier's tests on same, were published in the ELECTRICAL REVIEW for April 28th, 1883, but the following from the catalogue of Messrs. King, Mendham & Co. may meet the wants of our correspondent:—"Bichromate of Potash Battery.—Construction and Charge.—Carbon (positive) and amalgamated zinc plates (negative) in a saturated solution of bichromate of potash eight parts, and sulphuric acid one part. Electromotive force, 1.90 volts. A solution may also be made on M. Trouvé's plan, which gives a higher E.M.F. and renders the action of the battery more lasting; it consists of the same materials as enumerated above, the essential difference between the two being that the sulphuric acid is added drop by drop, so that the solution heats only very gradually, dissolving the whole of the powdered bichromate of potash. This action causes the solution to become super-saturated, and no chromic alum crystals are formed upon cooling. On account of the greater action on the zinc, perfect amalgamation of the metal is necessary, and is only accomplished by repeated application of mercury till a thick coating has been deposited. The following are the proportions of the different materials used in making this solution:—Water (cold), 36 oz. or 1½ pints, bichromate of potash (powdered, 8 oz., sulphuric acid 15 oz."—EDS. ELEC. REV.]

The Bell and Edison Telephone Patents.

With reference to the letters of Mr. Barney and "Common Sense" in your last issue, I think they are both wholly "at sea" with regard to the meaning of the words in the claims of the Bell patent, "but subject always to the disclaiming notes." They seem to regard this as enlarging the scope of the claims. I should like to know how the *disclaiming* notes can possibly extend the scope of the *claiming* notes. The very sense of the term is to qualify the preceding words of the claim by rendering them subject to, that is submissive to, the qualification contained in the *disclaiming* notes. "The alterations introduced into" the claims by adding these words do not extend their meaning, but subject them to a deduction. Is not Mr. Barney confusing the "alterations" with the "disclaiming notes"? I take the disclaiming notes to be the words commencing with "which is not claimed," on line 39, page 2, and ending with the words "atmospheric influences" on line 47 of the same page, and which is made to form the first paragraph of the "fourth plan." I submit that the alteration of a word here and a word there can in no sense be called the "disclaiming notes."

And, now, as to the substitution of the words "equivalent plate" for the word "material." The intention is obvious; but it as obviously fails. It fails for many reasons: first, a non-inductive plate would not be an "equivalent plate"; secondly, it does not describe how a non-inductive plate is to be used, or even mention such a plate itself, and, therefore, cannot be "*substantially as described*"; thirdly, that this alteration is merely in the explanation of the "fourth plan," and not in the claiming clauses, and, therefore, as the "fourth plan" commences with these qualifying words, "which is not claimed further than is indicated by the

claims made in the claiming clauses hereunto annexed," it follows that everything in the "fourth plan" is subordinate to the claiming clauses.

But what is this "ghost" which your two correspondents have simultaneously raised? Why it has not even the virtue of being a new "ghost"; in fact it has already been "laid," yes, judicially "laid"! The specification after describing a thin steel plate, and how it shall be fixed, says that it is not limited to a steel plate, but includes within its scope "any material" (now "equivalent plate") "capable of inductive action upon a current of electricity." Clearly, therefore, it all rests upon what is an "equivalent plate," and this, to me, seems a peculiarly simple question.

It must be borne in mind that the specification first describes the cone, membrane, and bar armature (now disclaimed), and then says instead of the cone, membrane, and armature, a plate of thin steel, such as is shown at A, fig. 31, may, with increased advantage, be used. There was an *improvement* in abolishing the two parts (membrane and armature) and substituting one part having the qualities or virtues of both. It was a simplification of the apparatus—a unification of the parts—and this in the eye of the Patent law, as well as in practice, was an improvement. It was a *tympan* that would vibrate in ripples having circular nodal lines, the same as the membrane; and it was, in addition, an *armature*—the two in one. It was capable of vibrating with the voice; and it was *inductive*. But stop; immediately you take away from it one of those properties it ceases to be an "equivalent plate." Replace it by a plate of wood, and it is not a plate capable of inductive action upon a current of electricity.

Put the plate of wood in place of the membrane and attach it to the bar armature, and you have once more the two parts; the non-inductive tympan and the bar armature. You have gone back to the old arrangements of divided parts. You have merely placed one substance in the place of another substance, having no additional property, and without simplifying the apparatus. No; the plate itself must have *all* the properties of the steel plate, and it is not an *equivalent* plate. It must be a plate *not affected by moisture*, the same as a wood plate, or the membrane; it must be a *tympan or drumhead*, capable of vibrating in ripples or circular nodal lines; and it must be an *inductive substance*. If it is all three it is an "equivalent" plate; if it is not it is outside the patent, and no amount of jerrymandering construction can bring it within. If the word "equivalent" was struck out, and plate left in, then I admit the patent would be bad; that is, if it were not also for the qualifying preface to the "fourth plan," which I have quoted. But as I have said before, this "ghost" has already been "laid" judicially. Mr. Barney and "Common Sense" need not trouble to urge the invalidity of the Bell patent in consequence of this alteration, as it has already been urged; and Mr. Justice Fry, considering this objection in his judgment, said:—"Lastly, it is objected that by his original specification Mr. Bell claimed to use for his disc or plate, either membrane or steel, or any inductive substance, and that by his disclaimer and memorandum of amendment he finds steel to be preferable, and claims, not any inductive substance, but any equivalent plate capable of inductive action. I am unable to see in this change anything that can affect the validity of the patent. The description of the subject matter of the plate is adequate; the plate described must be *inductive and equivalent to a steel plate* as regards its capacity to vibrate with the voice. When these qualities are found it seems to come within the description contained in the amended specification."

As to the "buzzing" spoken of by "Common Sense," I can only say again that in my opinion the induction from neighbouring wires, or the pulsatory movement of the contact, owing to the battery being too strong, or the contact too delicate, is the sole cause of the "buzzing." I know that everything has more or less a fundamental vibration of its own, and will respond with a musical note when the number of vibrations in a given time correspond to the pitch of the vibrator;

and in this sense interferes with the articulation. But this can scarcely be called "buzzing," and, moreover, it is present far more in a tongue than a tympan.

With regard to the Hughes microphone your correspondent says he is "quite clear that Hughes's microphone, as used by him, always was attached to a tympan." I join issue with him here, and defy him to produce a single shred of evidence that the Hughes microphone, as exhibited and described by Prof. Hughes, was attached to a *tympan*. He has not produced a single word or line of proof in support of his statement, but simply reiterates it. And it seems the more puzzling to me because I thought the point of public notoriety. However, what does Mr. Conrad Cooke say, and he was one of the four before whom Prof. Hughes first showed his invention. He says: "I have witnessed numerous experiments in which articulate speech was conveyed by the microphone without using diaphragms—in fact none of Hughes's use the diaphragm to convey articulate speech." I think it would be trifling with the valuable space allotted to your correspondents to say more upon this point now. The statement of "Common Sense" is utterly opposed to the meaning of his signature.

He also says that "although Edison disclaimed the resonant case it is clear that *such a case* cannot be used in combination with a tension regulator, because Edison has the claim of the combination of a tension regulator with a *diaphragm or tympan*." This paragraph ought to be printed in large letters and conspicuously exhibited outside the Coleman Street temple wherein "Ye Gods" hold court! The logic is admirable! the printer's "devil" could not improve it! After mature consideration I have decided not to assail such an impregnable position.

I must also leave Sir William Thomson's opinion that "a microphone lying on a marble slab was the same as the Edison combination" to a more appreciative posterity. I should like, however, to ask "Common Sense" if the transmitters he first spoke of as being without the vestige of a diaphragm were made of wood or stone; and by what means the "tension regulators" in them were held in position to be actuated by the sound-waves. A "tension regulator" cannot be hung upon a sunbeam, or ride upon a sound-wave, and, therefore, I am anxious to learn the mystery of its construction.

F. T. H.

Derby, December 8th, 1884.

Foreign Specifications.

Will you please inform me through your correspondents' column where I can purchase in this country foreign specifications of patents, particularly French, German, and U.S. America.

"Pentalpha."

Bradford, December 8th, 1884.

[Our esteemed correspondent, Mr. Handford, will probably be so kind as to give "Pentalpha" the information he requires.—EDS. ELEC. REV.]

Compound-Wound Machines.

I notice in your last week's issue a communication from the pen of Dr. Paget Higgs, in which he records a success recently achieved by him in winding constant-current dynamos. For several reasons the construction of a compound dynamo for constant current is more difficult of attainment than that of a machine for constant potential, and I am sure that the publication of the results obtained from Dr. Higgs's machine would interest many of your readers besides myself. I am not aware that results obtained from such a machine have been yet published, and Dr. Higgs would certainly confer a favour on those engaged in the construction of dynamos if he would give some details concerning the performance of the machines to which he refers.

W. B. Esson.

Dalston, E., December 8th, 1884.

PATERSON & COOPER, ELECTRIC LIGHT AND POWER AND TELEPHONE ENGINEERS,

ST. PAUL'S WORKS—76, LITTLE BRITAIN, LONDON, E.C., AND
EUROPEAN TELEGRAPH WORKS—POWNALL ROAD, DALSTON.

Prize Medals, International Electrical Exhibitions, Paris, 1881, London, 1882, and Calcutta, 1884.

MANUFACTURERS OF

DYNAMO MACHINES, ARC LAMPS, AND ALL ACCESSORIES FOR ELECTRIC LIGHT INSTALLATIONS.

DYNAMOS.—PATERSON & COOPER'S Phoenix Dynamos for Incandescent or Arc Lighting; Slow-speed Machines for Ship Lighting; Dynamos for Electro-Deposition of Metals.

SEARCH LIGHTS.—Submarine Arc Lamps for Salvage or Fishing.

ENGINES.—High Pressure and Condensing; Steam Boilers; Turbines, Water Wheels, Overshot Breast and Undershot; Shafting, Pulleys, Plummer Blocks, Gearing, Belting, &c.

ARC LAMPS.—Licensees and Manufacturers of the Clarke-Bowman Arc Lamp, the Pilsen Arc Lamp, the "T.F.," and other lamps.

INCANDESCENCE LAMPS.—Agents for Swan, Edison, Bernstein and other incandescence lamps.

MEASURING INSTRUMENTS.—Cardew's Universal Voltmeter, Paterson's Patent Electro-magnet Am and Voltmeters, and Engine-room Ammeters; Ayrton & Perry's Am and Voltmeters, Ohmmeters, Powermeters, Tachometers, &c.

CARBONS.—"WALLACE DIAMOND" Carbons, as used at Severn and Mersey Tunnel Works, Great Western Railway Company, International Health Exhibition, &c.; HARDTMUTH'S SOFT CORE CARBONS.

FITTINGS.—Sockets, Holders, Lamp Reflectors, Brackets, Improved "R.E." and Maynard Switches; Safety Cut-outs, and all requirements for electric light installations; Cables of all descriptions.

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